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WORLD CONFERENCE

THE United Nations Scientific Conference on the Conservation and Utilization of Resources (UNSCCUR) will convene at Lake Success, New York, next month. Sessions of the conference will cover a three week period from August 17 to September 6. Experts on all phases of resources from almost every country in the world will participate actively in the deliberations. How the world resources can best be harnessed and used for the improvement of living standards will be the underlying theme for discussion. The ultimate aim of the conference "is the enrichment of human life. The immediate program of the conference is to take a step in world improvement of resource techniques and know-how, one of the essentials in bringing this enrichment to reality."

The conference has been organized on the basis that each part of the world can contribute to the solution of problems in attaining these goals. Authorities in attendance will have an opportunity to add to their store of knowledge and apply to their own country the new techniques and methods they learn from experts from other lands. "This store of scientific and practical knowledge is, in itself, one of the world's greatest resources—one that grows with use and is enlarged by sharing. The fullest possible mobilization of this knowledge is considered essential to equip the nations of the world for their task of raising and maintaining the living standards of their people."

One of the unusual features of the conference is that the authorities who participate, do so as individual experts and not as representatives of their governments or other organizations. The state of the world's resources, including their potential volume, will be examined. Depletion of these resources will be estimated and the legacy of their past waste and misuse will also come in for close scrutiny. Existing critical shortages will be reviewed.

One of the specific subjects for discussion is fuels and energy resources. In this category will fall petroleum. When this subject comes up for consideration, the United States' representatives will have much to contribute and will be looked to for guidance on these resources.

This conference is the first of its kind and because of the broad scope of its program, it may be far-reaching in its results on the ultimate economic structure of the world in general and individual countries in particular. In effect, here is born a clearinghouse for interchange of ideas and discussions of problems that confront nations on the most efficient means for developing natural resources. The possibilities for ultimate good that can accrue from this interchange of scientific knowledge for immediate practical application is far-reaching and beyond any ordinary means of appraisal.—K.C.S.

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Scanning WASHINGTON'S OIL HORIZON

By MILBURN PETTY

WASHINGTON—The outlook now is for a long-continuing investigation of oil prices, with a special senate committee seeking answers to questions such as "what keeps the price of crude up" and why gasoline advanced in price when other products declined.

At the very outset, Chairman Maybank, South Carolina, was asked by Senator Tobey, New Hampshire, whether this was going to be "an inquiry with padded gloves or are we going to dig into the guts of what's going on in the oil industry." Maybank assured him that the committee was determined to get to the bottom of things.

The investigation was launched with charges by three successive witnesses that independent refiners and marketers were being squeezed, the consumer gouged, and maritime labor oppressed by practices of the major oil companies.

▸ **Proration Hit.** The first witness charged that gasoline prices "have been rigged through curtailment of crude oil production." He was W. L. Heinz, secretary of the South Carolina Oil Jobbers Association. Had Texas permitted the law of supply and demand to operate on crude prices, there would have been a decline—just as there was in Pennsylvania where crude prices dropped from $5 to $3.27, Heinz declared.

▸ **Prices Defended.** First oil company rebuttal witness was A. L. Nickerson, Socony-Vacuum's general sales manager, who said "with fuel prices softening and gasoline firm, we had to realize more for gasoline to help cover the undiminished cost of a barrel of products." Even with the April gasoline price rise, the Gulf Coast refinery margin was 48 cents per barrel in May as compared with 59 cents in March and 75 cents for all of 1948 and 79 cents for 1947, Nickerson said.

▸ **Important Probe Pushed.** Not satisfied with the testimony of New Jersey Standard President Holman on the effect of imported oil on domestic producers, Congressman Patman's Small Business Committee has sent a 32-point questionnaire to the importing companies seeking to pin them down to an admission that imports are "supplanting" domestic production in meeting U. S. demand.

Jersey's position was that the question of whether imports are "supplementing" or "supplanting" domestic oil does not arise so long as the U. S. is producing more than it consumes domestically, excluding exports. Such a situation exists now, according to Holman, who said imports averaged 513,000 bbl a day while "total movements of oil out of the country" were 635,000 bbl a day during 1948.

This was disputed by the Independent Petroleum Association of America, contending that domestic producers should get first call on supplying U. S. demand including a normal volume of exports. Also IPAA points out, Holman used the Bureau of Mines figure on imports, 513,000 bbl a day, but not the B. of M. export figure, 368,700 bbl a day.

▸ **Krug Asks Study.** Question of whether or not the U. S. was a net importer in 1948 turns on the definition of "export." This difference of opinion will be threshed out if the National Petroleum Council complies with Secretary Krug's request that the NPC make a study of the import situation and submit recommendations. Along with that, Krug wants the Council to study how to provide a "cushion" of reserve productive capacity for use in an emergency.

▸ **ECA.** A delegation from London is expected here soon to confer with the Economic Cooperation Administration on the size of the British refinery program. Privately, ECA officials admit there isn't much that can be done about it if the British do not go along with ECA's views on cutting back refinery expansion programs because, if they so desire, the British could finance some of the expansion outside the Marshall Plan. The British didn't make it any easier for ECA to get the Marshall Plan appropriation through Congress by their official press release that refinery capacity of the United Kingdom was to be expanded eight-fold.

▸ **Tankers.** The CIO Maritime Committee is continuing its fight against American oil companies operating their tankers under foreign flags, aided by hearings being conducted by Washington Senator Magnuson's special committee asking "why" this is necessary. New Jersey Standard's answer was simple—operating costs are 25 per cent higher under the U. S. flag. Of this cost differential, 96 per cent is represented by lower wage scales paid on foreign-flag vessels, ranging from 58 per cent down to 26 per cent of the American flag wage rate. Jersey says its domestic tanker requirements are 190 per cent covered, so its new 26,000-ton tankers must go under foreign flag unless U. S. Maritime Commission reconsiders its previous turndown and permits transfer of six older tankers to other flags.

▸ **Royalty Oil.** Relief is in sight for those independent refiners who have premium price contracts to buy government royalty oil. Senator O'Mahoney (D, Wyo.) expects to get prompt action on his bill to cancel the premium payments, retroactively to February 1, 1949. "Many refineries," O'Mahoney's committee said in reporting the bill favorably, "have been operating at a loss even at those (posted) prices without absorbing a premium as well."

▸ **Gas Bill.** Federal Power Commission still has authority to control field prices for natural gas, despite the Supreme Court's recent decision holding that leases and reserves come within the production-and-gathering exemption of the Natural Gas Act, so it is still necessary to enact the Kerr Bill specifically exempting independent producers and gatherers from FPC's jurisdiction.

▸ **Basing Points.** Whether or not Group 3 pricing could ever be classed as a "basing point" system, the petroleum industry will breathe easier when the O'Mahoney Bill is enacted, as is now expected. Besides "clarifying" a seller's right to sell at delivered prices and absorb freight (in the absence of collusion or monopolistic practices), the bill in its final form probably will confirm a seller's right to meet competition in good faith, which was denied by the appellate court in the Robinson-Patman Law Case against Indiana Standard at Detroit.

▸ **Synthetics.** The military has served notice that it is not ready to back the grandiose plans of the Interior Department to launch a synthetic fuels program costing many billions of dollars "as long as the American oil industry continues to meet demands from natural petroleum." However, the military does favor enactment of the McCarran Bill proposing government loans of several hundred millions to build private synthetic fuel plants or for the government to build such plants itself, if private industry is not willing.

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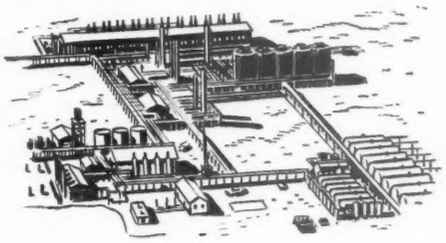
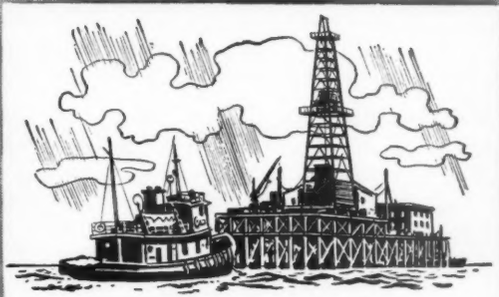


● Shell Oil Company's TXL Gasoline Plant near Odessa, Texas. This is a prime example of Brown & Root's flexibility in meeting the demands of a client's changing conditions. The original contract called for a 30,000 mcf gasoline plant. During plant construction the mcf was revised to 45,000. Shortly after completion, the throughput demands were raised to 90,000 mcf . . . triple the original requirements! Farsighted planning by Brown & Root engineers allowed continuous plant operation while this tremendous project was effected.



● Offshore drilling. Derrick foundation constructed by Brown & Root Marine Operators, Inc., for a drilling operation far out in the Gulf of Mexico. "Brown-Bilt" in six fathoms of open water, its crown block towers 237 feet above the floor of the turbulent Gulf. It must withstand not only storms of hurricane strength but also the rigors of heavyweight rotary drilling operation.

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HIGHLIGHTS in Oildom

Increased Demand Seen. According to a Bureau of Mines official, the demand for oil will increase "significantly" the latter part of this year. Thomas H. Miller, acting director of the Bureau, stated that an abrupt decline in demand developed at the beginning of 1949, and under this condition there is little doubt that the influence of imported oil has been felt, particularly in Texas which has absorbed the major part of the decline in demand.

Louisiana Tidelands Suit. Whether Louisiana likes it or not it is being sued, the Supreme Court has informed that state. The Court has overruled a plea by Louisiana's attorney general for a new hearing, on his protest against filing of the Federal Government's tidelands suit. In protesting the Court's consideration of the case, Louisiana has contended a state could not be sued without its consent. Failure to answer the government's complaint in the tidelands case by September 1, would allow the Federal Government to ask for a judgment against Louisiana for her tidelands without consent of the state, the Court ordered.

Canadian Oil Empire. North American oil companies are spending vast sums on Western Canadian fields—about $100,000,000 this year—and are planning larger programs later to develop the area. Discovery and development of Canada's oil is due largely to freedom allowed private companies. As in the U. S. competition is strong with numerous firms moving into the area and buying up leases for exploration. Canada's relationship with free industry is in wide contrast to that of our southern neighbor, Mexico.

Workers Hit Contract. Despite the signing of a new labor contract calling for approximately 14 per cent wage increase, Mexico's petroleum industry is still having its troubles. Although the government expropriated practically all foreign oil company properties a decade ago, "imperialists" are still being blamed for Mexico's petroleum difficulties.

Petroleos Mexicanos officials said recently that the government monopoly is losing $22,000,000 a year. They are seeking a loan of $203,000,000 in Washington to be used in development of the industry but have small chance of getting it. Private American companies have no desire to develop Mexican areas because of the highly restrictive terms that Pemex offers.

Only President Truman seems to favor the loan. He voiced his approval at a press conference.

Natural Gas Act. Although the Supreme Court has ruled that the Federal Power Commission does not have jurisdiction over "production and gathering of natural gas," oil men still contend that legislation is required to clarify the Natural Gas Act. The FPC had sought to distinguish the activities of production and gathering such as drilling, well spacing, or collecting gas and the facilities such as reserves and gas leases and argue that only the former were excluded from the coverage of the Act. The Supreme Court refused to accept this distinction.

The Senate Interstate Commerce Committee vote has approved Senator Robert Kerr's bill exempting from federal rate controls natural gas sold to pipe line companies. This would more clearly state FPC powers.

Modify Dealer Contracts. Standard Oil of California is moving immediately to modify its agreements with approximately 6000 independent service station operators. The action is the result of the five-to-four decision of the United States Supreme Court invalidating dealer contracts calling for exclusive handling of Standard's production. Standard stated that the Court had ruled that the dealer contracts constitute a violation of Section 3 of the Clayton Act, although it did not sustain the ruling of the lower court that a violation of the Sherman anti-trust law was involved.

Sue on Tidelands Leases. The dispute on tidelands ownership has resulted in five major oil companies filing suit to be relieved of their obligations. The Texas, Humble Oil and Refining, Stanolind Oil and Gas, Magnolia Petroleum, and Shell Oil Companies, who own about 40 per cent of the Louisiana tidelands oil leases, have sued the Louisiana State Mineral Board.

They asked a declaratory judgment that, until the suit by the U. S. against Louisiana for ownership of the tidelands is disposed of, the oil companies' rights under the leases would be suspended. They also asked that their obligation either to drill on the acreage or to pay the state rental be suspended.

Romanian Oil Conflict. Yugoslavia's official press has charged the Soviet union is appropriating Romania's rich raw materials, particularly oil. The Yugoslav Communist party newspaper Borba has stated that widespread discontent, strikes, and sabotage have resulted in Romania because of Russia's demands upon her economy, especially for oil. The article said only a fifth of the oil tapped from Romania's wells is allowed to remain in the country, with the balance being removed to Russia as war reparations or as property of the Soviet-controlled corporation, Sov Petrol. The article added that "saboteurs" were responsible for heavy damage of goods designed for export and of property of Argus, the Romanian Oil Company.

Italian Oil Well. The Azienda Generale Italiana Petroli's first reports that discovery of Italy's first well would "radically transform" the Italian economy have been tempered somewhat. The Italian Government has issued a statement pointing out that the most optimistic estimate of the new field's capacity is production of 20,000 bbl per day after several years of development. Geologists have long predicted that oil would be found in the Po Valley region, but whether the field will prove to be a prolific one remains to be seen.

Pleads for Recognition. Testifying before the Senate Banking and Currency Committee, A. L. Nickerson, director and executive in charge of domestic marketing for Socony-Vacuum Oil Company made a strong appeal for government recognition of the "social performance" of the petroleum industry. His appearance was in connection with the committee's inquiry into oil industry prices and profits. Nickerson told the committee that although the oil industry did not feel entitled to an exceptionally large profit reward for its social performances, a profit record had to be viewed against the overall good it has done the public and country before a sound appraisal could be given. Nickerson is the only representative of a major company so far scheduled to testify.

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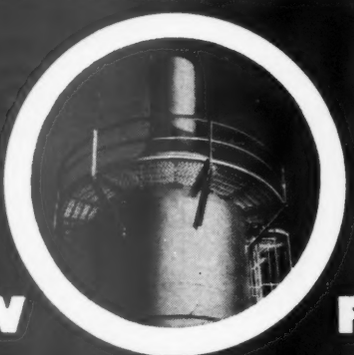

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National Petroleum Situation

Imports up 26 Per Cent. Imports of crude oil and products in the first half of this year were 26 per cent above the same period last year. Preliminary estimates place the total through June 30 at 108,185,000 bbl, against 86,573,000 bbl last year. The daily average this year was about 600,000 bbl, against 475,00 bbl last year. Receipts of foreign oil in May and June were at the rate of about 625,000 bbl daily.

Stocks Move Higher. Despite curtailment of crude production and reduced refining operations, stocks of all oils continued to climb in both April and May. Estimates, based upon weekly reports of The American Petroleum Institute and the Bureau of Mines, indicate a further increase in stocks of all oils on May 31 of 6,366,000 bbl, compared with an increase in April of 5,835,000 bbl. In the first 5 months of this year, stocks of all oils increased 21,302,000 bbl, compared with an increase in the corresponding period of last year of 12,191,000 bbl. Stocks of all refined products, including natural gasoline, were 24 per cent above last year, while crude stocks were about 20 per cent greater. While motor fuel stocks are 10 per cent above last year, current supply is 42 days against 41 days a year ago.

Production Off 6 Per Cent. Crude production in the first half of this year was about 5 per cent under last year. Preliminary estimates place this year's daily average at 5,147,000 bbl, against 5,429,000 bbl in 1948. Analysis of crude supply statistics for May, computed on a Bureau of Mines basis, indicates that production and imports exceeded requirements by about 126,000 bbl daily. Reports for the first 5 months of this year indicate a reduction in crude supply under last year of about 99,000 bbl daily, while demand for these comparable periods was 234,000 bbl lower.

Drilling Up 14 Per Cent. Wells drilled in the first half of this year, excluding service and input wells, were 14 per cent above last year, while wildcat operations were 16 per cent greater. Completions totaled 18,083, against 16,573 last year. Wildcats, included in this number were reported at 3,233, against 2,787 last year. Wildcat dry holes averaged 82 per cent, while the average dry hole percentage for all wells drilled was about 33 per cent. New drilling operations reported on June 1 totaled 4,915, against 4,700 a year ago; an increase of 5 per cent.

Comparative Statistics, May, 1949

*All figures are computed on a Bureau of Mines' Basis**

	May 1949Ⓟ	April 1949Ⓟ	May 1948	This year to date	Last year to date	Per cent change
Total supply, all oils	186,575	180,492	197,458	936,614	953,985	— 2
Daily average	6,018	6,016	6,370	6,202	6,276	
Total demand‡, all oils	180,209	174,657	184,006	915,312	941,794	— 3
Daily average	5,813	5,821	5,936	6,061	6,196	
Change in stocks	+6,366	+5,835	+13,452	+21,302	+12,191	
Crude supplyⓅ	167,400	162,312	180,867	846,581	867,194	— 2
Daily average	5,400	5,410	5,834	5,606	5,705	
Crude demand‡	163,500	157,683	184,055	825,338	866,530	— 5
Daily average	5,274	5,256	5,937	5,466	5,700	
Crude stocks	277,870	273,970	231,318	277,870	231,318	+20
Days supply	52	52	39	52	39	
Natural gasoline production	13,200	12,336	12,044	63,365	59,329	+ 7
Daily average	425	411	390	419	390	
Motor fuel production	83,370	78,900	79,421	393,431	366,995	+ 7
Daily average	2,700	2,630	2,562	2,606	2,414	
Gasoline yield per cent	45.8	44.1	40.8	43.1	39.2	+ 3.9
Motor fuel demand‡	88,110	81,503	80,813	375,607	349,298	+ 8
Daily average	2,842	2,716	2,608	2,487	2,300	
Motor fuel stocks	120,100	124,840	108,552	120,100	108,552	+10
Days supply	42	45	41	42	41	
Fuel oil production	63,950	63,350	71,496	334,244	356,398	— 6
Daily average	2,063	2,111	2,306	2,213	2,345	
Fuel oil demand‡	62,800	66,043	66,283	380,886	401,475	— 5
Daily average	2,026	2,201	2,138	2,522	2,641	
Fuel oil stocks	117,320	110,170	89,299	117,320	89,299	+32
Days supply	58	50	41	58	41	
Refinery still runs	160,450	154,223	175,705	809,327	830,720	— 3
Daily average	5,176	5,140	5,668	5,360	5,465	
All refined stocks	349,175	346,709	281,673	349,175	281,673	+24
Days supply	59	59	48	59	48	

Current Crude Oil Prices

U. S. Average	$2.55	Louisiana	$2.62
Texas	2.61	Arkansas	2.43
California	2.42	New Mexico	2.40
Oklahoma	2.63	Mississippi	2.26
Kansas	2.62	Illinois	2.76
		Other states	2.60

Basic crude prices:	
Oklahoma-Kansas (36 gr.)	$2.57
Texas Gulf Coast (36 gr.)	2.80
East Texas	2.65
West Texas (36 gr.)	2.44
California Signal Hill (26 gr.)	2.31
Pennsylvania, Bradford	3.40

Drilling and Production Statistics

	May 1949Ⓟ	April 1949Ⓟ	May 1948	This year to date	Last year to date	Per cent change
Wells drilling	4,915	4,850	4,700	4,915	4,700	+ 5
Total wells drilled	3,474	3,207	3,384	15,474	14,339	+ 7
Development wells	2,735	2,520	2,661	12,270	11,183	+10
Oil	1,851	1,718	1,854	8,425	7,932	+ 6
Gas	255	227	201	1,100	907	+22
Dry	629	575	606	2,745	2,344	+17
Per cent dry	23.0	22.8	22.8	22.4	21.0	+ 1.4
Service wells	106	125	189	571	870	—34
Wildcat wells	633	562	534	2,633	2,286	+15
Oil	78	102	90	416	330	+26
Gas	11	13	18	62	102	—39
Dry	544	447	426	2,155	1,854	+16
Per cent dry	85.9	79.4	79.8	81.8	81.1	+ 0.7

By State

Wells drilled (excl service)	3,368	3,082	3,195	14,903	13,469	+10
Arkansas	34	37	27	126	126	
California	218	221	264	1,061	1,156	— 8
Illinois	223	148	226	854	804	+ 6
Kansas	298	274	308	1,230	1,127	+ 9
Louisiana	164	143	220	830	821	+ 1
Mississippi	37	33	39	150	157	— 4
New Mexico	47	40	50	211	255	—17
Oklahoma	401	426	374	1,626	1,578	+ 3
Texas	1,312	1,109	1,030	5,824	4,463	+30
Other states	634	651	657	2,991	2,982	
Wildcats drilled (incl above)	633	562	534	2,633	2,286	+15
Arkansas	5	6	6	22	36	—39
California	37	34	38	202	145	+39
Illinois	48	27	31	148	140	+ 6
Kansas	50	29	51	193	176	+10
Louisiana	31	33	24	126	103	+22
Mississippi	14	3	8	44	38	+16
New Mexico	7	4	3	35	22	+59
Oklahoma	74	70	83	295	332	—11
Texas	289	270	217	1,226	964	+28
Other states	78	86	73	342	330	+ 4
Daily crude p duction	5,000	5,012	5,502	5,193	5,406	— 4
Arkansas	83	81	85	84	85	— 1
California	931	939	946	941	938	
Illinois	180	179	173	175	173	+ 1
Kansas	298	301	312	295	293	+ 1
Louisiana	522	514	492	518	481	+ 8
Mississippi	109	110	123	111	119	— 7
New Mexico	130	135	129	133	128	+ 4
Oklahoma	450	427	418	431	407	+ 6
Texas	1,895	1,938	2,454	2,128	2,417	—12
Wyoming	106	111	148	118	143	—18
Other states	296	277	222	262	222	+18

*Unless otherwise stated all figures represent thousands of barrels. Ⓟ–Preliminary. *Includes domestic production and imports.
‡Total demand, including exports. Note—May and cumulative data revised to reflect changes in reporting by U. S. Bureau of Mines.
Preliminary estimates based upon data supplied by American Petroleum Institute, U. S. Bureau of Mines, State Agencies, and other official sources.

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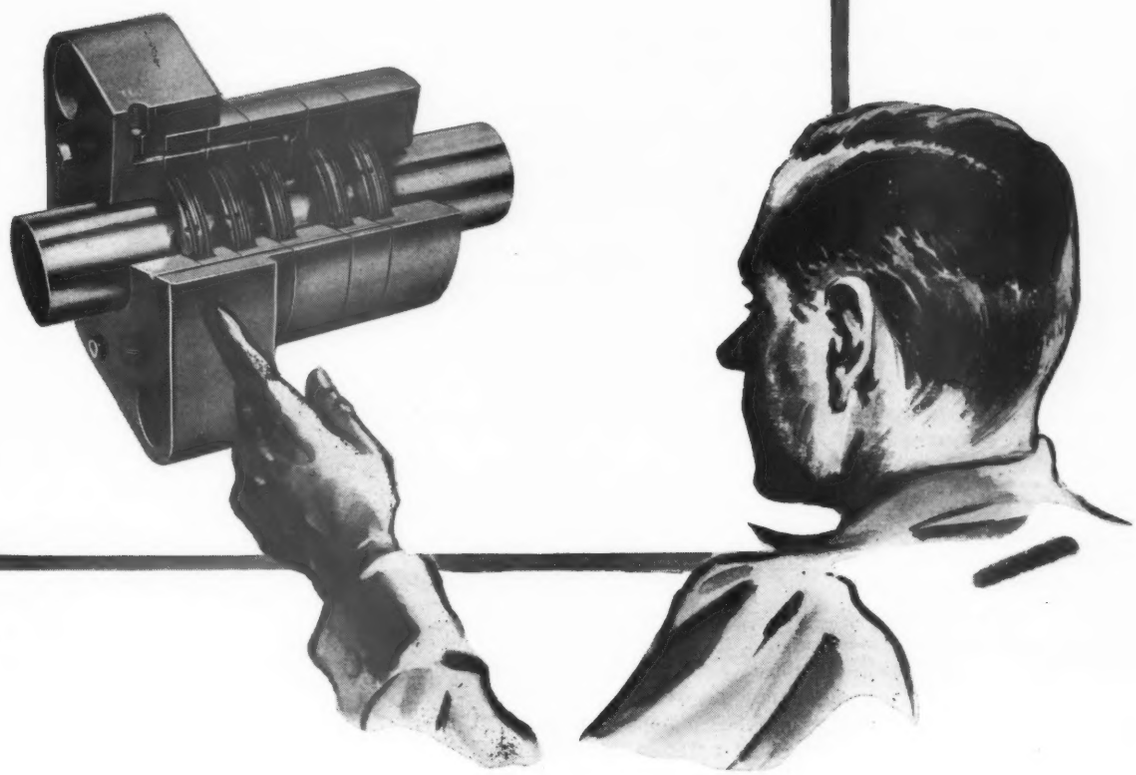

Precision in Cook Packings means more than holding to close dimensional tolerances. It means careful control of every detail of construction—from the initial engineering design, through the refinement of the materials used, to the final assembly of the component parts.

This "precisioneering" pays off in end results. It means that Cook Packings are built from start to finish to provide your compressors with maximum sealing at minimum costs. "Precisioneering" is the reason why Cook Packings give longer service, why they cut overhauls, repairs and costly delays.

Proof of their performance is found in the fact that Cook Packings are the standard for refinery, repressuring, recycling and natural gas pumping compressors.

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COOK
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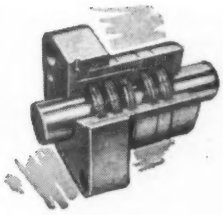


. . . SEALING PRESSURES SINCE 1888 . . .

Mr. Pepys

To lunch a few days ago at the Virginia Country Club, Long Beach, with Julian Campbell, the pioneer natural gasoline researcher and developer, and his son, Ralph, a pleasant young chap with ambitions to be a medicine man. It is a laudable ambition, too—there is certainly a pressing need for more doctors in these modern times when so many new diseases are being discovered. Not long ago our Edinburgh great-uncle, Angus McBagpipes, in a serious extremity was unable to find a doctor. So, he used one of these home medicine books, and we have just had word that he died of a misprint. What we really started out to tell you about, however, was that while we were stuffing ourself unrestrainedly with the good Virginia Club roast duck, and probably causing the Campbell family (they're Scots, too) considerable anxiety, who should come over to say hello but Frank Schlemmer. It is hard to believe that Frank was once just an ordinary Angeleno and here he is now a Texas Company purchasing biggie in the biggest village in these United States. He hasn't changed a bit though—is still a real citizen, and popular as all get out in these parts. We hear tell that a few days after we bumped into him, the Nineteeners, an exclusive organization of which he is a member, honored him no end at a directors' dinner at the Wilshire Country Club. He informed us that he was out here from New York on a vacation trip, renewing acquaintance with some old friends, and having a tiptop time generally.

Propaganda

The Geological Grandfathers' Society of Dallas has rerecently been enlarged by the sum total of one, through the graduation of Bill Clawson, Magnolia's chief geologist. Bill was so pleased with the acquisition of his new relative and responsibilities that at a recent dinner dance he carried a neatly lettered sign on his coattails announcing the event to all and sundry. This arrangement created such wide spread interest that he is now making a deal with one of the large agencies to lease out other parts of his anatomy for advertising purposes. All of which recalls that when we asked the little boy next door if their new baby was a boy or a girl, he replied, with obvious disgust, "Aw, it's just a girl—I seen them puttin' powder on it!"

Also, still anent the Dallas area, we understand that there is a nasty epidemic of eyestrain among the local engineers since Ralph Maddox, chief accountant for the Big West Drilling Company, appeared at the Dallas Petroleum Engineers' Club picnic in a vivid pink shirt with extravagant white polka dots. When he first arrived it was thought he had contracted some virulent skin disease, but upon closer examination the effect was seen to be caused, amazingly enough, by a shirt—but what a shirt! Ralph, we might mention in passing is the son of a Baptist minister, spent most of his younger days around Laurel, Mississippi, and will, we hope, appreciate one of Stephen Leacock's favorite clerical yarns.

Doctor? Doc-tor!

Leacock was professor of political economy at McGill University in Montreal, when we were a resident of that interesting city some years ago, and by way of relaxation he wrote some of the best humor we have ever read. He was also an excellent after-dinner speaker, and he occasionally told this story on himself: After he got his Ph.D., he was so proud of it that for a time he always signed his name, "Dr. Leacock." Once he booked passage to Europe on one of the big liners, signing the register, of course, as usual, "Dr." The ship had scarcely got under way when one of the officers called at his cabin, presented the Captain's compliments, and asked him if he would come at once and take a look at the chief stewardess's leg—she had fallen and injured it. Leacock accepted the commission and dashed to the aid of the stewardess without loss of time. But with all his speed he was still too late, another doctor had beaten him to it—a doctor of divinity.

Seven-League Boots

Milling around among the Nomads at the last monthly meeting in the Los Angeles Jonathan Club we were suddenly arrested by the nostalgic sound of a Gaelic tongue that rolled its r's in a most reckless manner. Tiptoeing over to the particular human cluster from which the whirring emanated we discovered Happy Sanders dispensing the latest Scotch story in the vernacular to a laughing group of well traveled equipment and supply men.

Happy has been something of a traveler himself since he first opened his eyes in Coalgate, Oklahoma, and found himself surrounded by oil wells. He really went seriously into the petroleum business in 1919 with the Empire Pipe Line Company at Okmulgee, and in the meantime his record of world excursions make the voyages of Lemuel Gulliver seem like a series of trips on a suburban trolley. His first foreign assignment was with Tropical Oil Company in Cartagena, Colombia, where he remained for seven years, after which, speaking Spanish like a native, he returned to California and organized the Hapsco Pipe and Supply Company. He was on his way to North Persia in 1938 but because of some national disturbance was halted in Syria. There he had his first meeting with Harry Huskey at the Metropole Hotel, and later was sidetracked to the Ameranian Company on Bahrein Island.

He helped drill the first wildcat well at Abu, Hadryria about which, incidentally, he wrote an article for *The Petroleum Engineer* in 1940. By 1943 he was at the Panama Canal on a special government assignment. He has worked in Turkey for Drillex Company, and, indeed, there are few oil-producing countries in which he hasn't spent some time. Besides being a linguist of no mean order. Happy has all the attributes of a successful vaudevillian. He mimics a Scot or a London cockney so faithfully that even they can't tell the difference, and he is thus much in demand as an after dinner entertainer. To top all the accomplishments we have enumerated, the tomatoes Happy grows in his Fullerton garden are so big that he wrenched his shoulder showing us the size of them.

Doodling

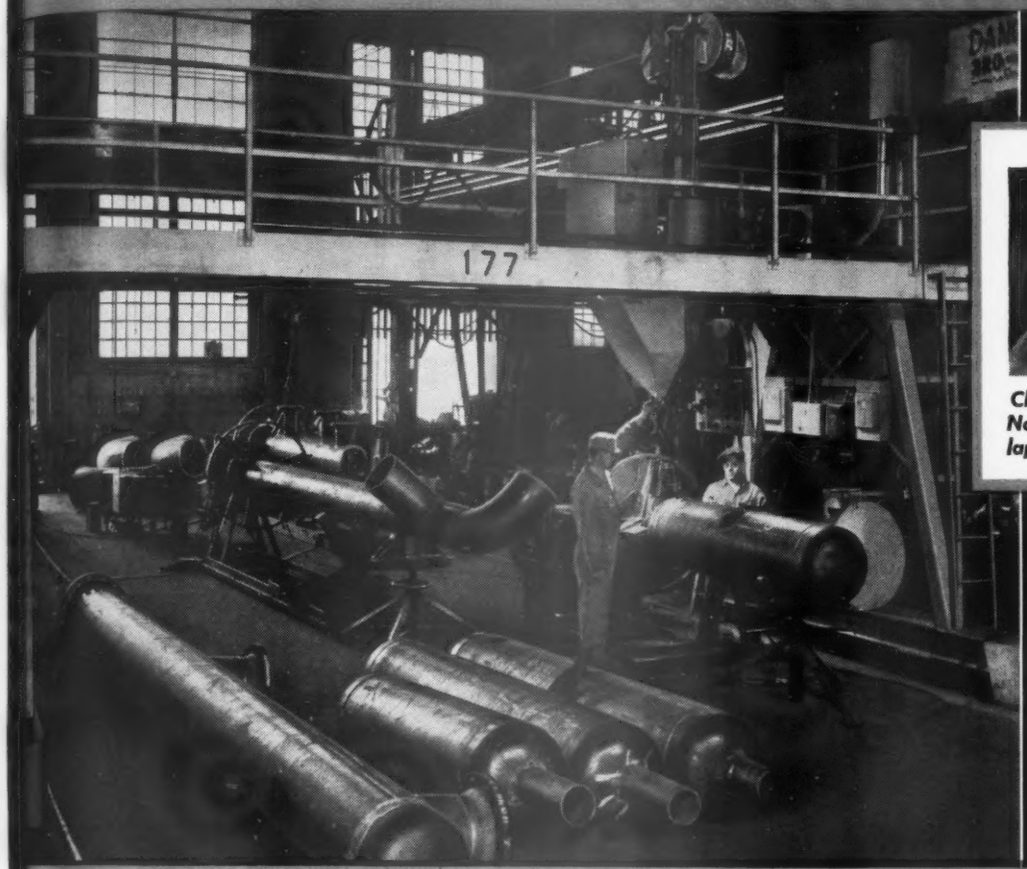
Ralph Paine, the Standard of California pipe line chief, was once the recipient, so we are told, of as cute a work report as we have run across in a long time. It was turned in by a newly appointed line walker who obviously found his job much tougher than he had expected. In any case the report, covering his first day's work, was brief and quite pointed, at least in one particular. It ran about as follows:

Number of bell holes dug	9
Number of pinholes plugged	23
Number of saddles attached	4
Number of miles walked	84
Number of feet aching	2
Number of days I will continue in this job	0

Gobbledygook

Pete Mensonides, vice prexy of Farrar and Trefts, Buffalo, New York, journeyed to Dallas a short time ago to discuss with local engineers how to bring about the conjunction and adhesion of two dissimilar and separate metallic units into a single entity by the application of heat; and how to evaluate the lasting coalition so formed. At least, we were told that his subject was welding and welds, which is what we have just remarked in much simpler verbiage.

PREFABRICATED PIPING IS IMPROVED

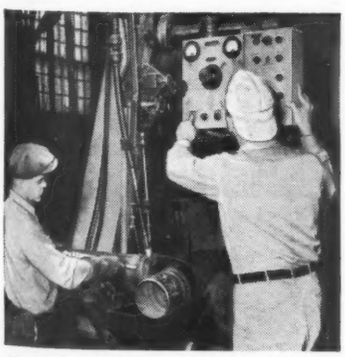


Closeup of the weld being laid. Note smoothness of the overlapping beads.

Movable bridge transports welding head and equipment over the various work rotating machines. Operator is shown adjusting flow of flux that submerges the arc; helper cleans weld with chipping hammer as it rotates past him.

by MIDWEST MACHINE WELDING

WITH SUBMERGED ARC



Operator stops machine at completion of weld by simply pressing button. Push button controls position welding head exactly over work clamped in rotating machine.

Better welding is assured by this Midwest development because the "human element" has been eliminated for all practical purposes. Aside from work positioning, the operator simply starts and stops the machine; his helper chips off the slag . . . all else is automatic.

Quality of the weld is improved because the machine follows the predetermined procedure *exactly . . . everytime*. The puddle is larger and the arc is better shielded and controlled. The possibility of locking up slag is minimized while undercutting is practically impossible. The greater number of beads is a further improvement.

This application equipment, developed and built by Midwest for use in its own fabricating plants, is representative of the modern facilities used by Midwest to assure better piping.

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QUALITY in world famous W-S Forged Steel Fittings starts with proper selection of basic metals. Long before problems of forging, machining and testing arise, W-S technicians concern themselves with end uses in the determination of proper steel analysis for the various jobs Fittings must perform.

For example, working closely with Refinery engineers, W-S technicians helped establish standards for the physical properties of various fittings alloys . . . were first to use fitting materials of closely controlled uniformity (low sulphur-low phosphor) for the special demands of refinery services.

And, W-S has kept pace with changing methods in other processing industries too, meeting each new challenge with stronger, tougher alloys, producing forged fittings always correct — metallurgically.

They meet the broad, diversified needs of all industry and are available in both screw and socket weld types. Forged and precision machined of stainless, carbon and alloy steel . . . . Investigate.

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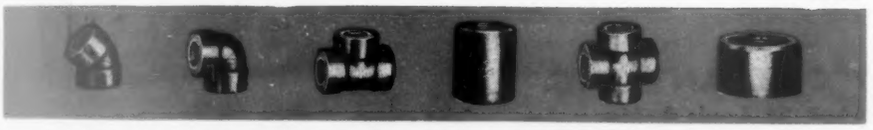

SOLD THROUGH LEADING DISTRIBUTORS

MEETINGS

Aug. 8—Nomads, Ye Ole College Inn, Houston, Texas.

Aug. 10—Nomads, Jonathan Club, Los Angeles, California.

Aug. 17-Sept. 6—United Nations Scientific Conference on the Conservation and Utilization of Resources, U. N. Interim Headquarters, Lake Success, N. Y.

Aug. 17-19—SAE, West Coast Meeting, Multnomah Hotel, Portland, Oregon.

Sept. 1-13—Interstate Oil Compact Commission, Quarterly Meeting, Stanley Hotel, Estes Park, Colorado.

Sept. 12-16—Instrument Society of America, Annual Meeting and Exhibit, Municipal Auditorium, St. Louis, Mo.

Sept. 14-16—National Petroleum Association, Hotel Traymore, Atlantic City, N. J.

Sept. 14-15—API, Lubrication and Marketing Division, Hotel Traymore, Atlantic City, N. J.

Sept. 17-20—AGA, Annual Convention, Chicago, Ill.

Sept. 18-20—American Institute of Chemical Engineers, Mt. Royal Hotel, Montreal, Canada.

Sept. 19-21—American Association of Oilwell Drilling Contractors, Annual Meeting, Baker Hotel, Dallas, Texas.

Sept. 19-21—National Butane-Propane Association, Jefferson Hotel, St. Louis, Mo.

Sept. 22-23—Mid-Continent Oil and Gas Association, Annual Convention, Louisiana-Arkansas Division, Roosevelt Hotel, New Orleans, La.

Sept. 25-28—American Institute of Mining & Metallurgical Engineers, Regional Meeting, Neil House, Columbus, Ohio.

Oct. 2-5—American Society of Mechanical Engineers, Petroleum Division, Petroleum Mechanical Engineering Conference, Biltmore Hotel, Oklahoma City, Okla.

Oct. 3-4—National Assn of Corrosion Engineers, Annual Meeting, Adolphus Hotel, Dallas, Texas.

Oct. 3-5—National Lubricating Grease Institute, Annual Meeting, Roosevelt Hotel, New Orleans, La.

Oct. 5-7—American Institute of Mining & Metallurgical Engineers, Fall Meeting, Petroleum Branch, Plaza Hotel, San Antonio, Texas.

Oct. 7—California Natural Gasoline Association, Ambassador Hotel, Los Angeles, Calif.

Oct. 10—American Society for Testing Materials, Pacific Area National Meeting, Hotel Fairmount, San Francisco, Calif.

Oct. 13-14—Texas Mid-Continent Oil and Gas Association, Annual Meeting, Rice Hotel, Houston, Texas.

Oct. 20-21—American Institute of Mining & Metallurgical Engineers, Fall Meeting, Petroleum Branch, Elk's Club, Los Angeles, Calif.

Oct. 31—Independent Natural Gas Assn of America, Annual Meeting, Baker Hotel, Dallas, Texas.

Nov. 7-10—API, Annual Meeting, Stevens Hotel, Chicago, Ill.

1950

Mar. 23-24—New England Gas Association, Hotel Statler, Boston, Massachusetts.

Apr. 12-14—National Petroleum Association, Hotel Cleveland, Cleveland, Ohio.

Apr. 3-6—National Association of Corrosion Engineers, Jefferson Hotel, St. Louis, Missouri.

Apr. 23—American Association of Petroleum Geologists, Chicago, Illinois.

June 19-24—Canadian Gas Association, Annual Meeting, Manoir Richelieu, Murray Bay, Que., Canada.

Sept. 13-15—National Petroleum Association, Hotel Traymore, Atlantic City, New Jersey.

Nov. 13-16—API, Annual Meeting, Los Angeles, California.

Canadian Power Project runs rings around its schedule

In mountain country, one hundred and thirty miles north of Vancouver, British Columbia Electric Co., has built a new hydroelectric plant. One thousand tons of water must be piped down a 41° mountain every minute! It called for a penstock (pipe lines) over 75″ in diameter. Special pipe couplings had to be designed to withstand the pressures never before attempted at such diameters.

Dresser Manufacturing Division got the task because it specializes in solving difficult pipe joint problems. It can tackle with assurance what has never been done, because it is part of a large company with facilities covering every type of pipe line, for water, gas and oil as well as machinery, the pumps, compressors or blowers, at both ends.

The new couplings Dresser engineered, tested at 1,300 lbs. per sq. in. They reduced construction time from months to weeks and the job was completed months ahead of schedule. This sort of thing is why the Biggest Jobs Are Going to Dresser. Address inquiries about any aspect of pipe lines and penstocks to Dresser Industries, Inc., Cleveland, Ohio.

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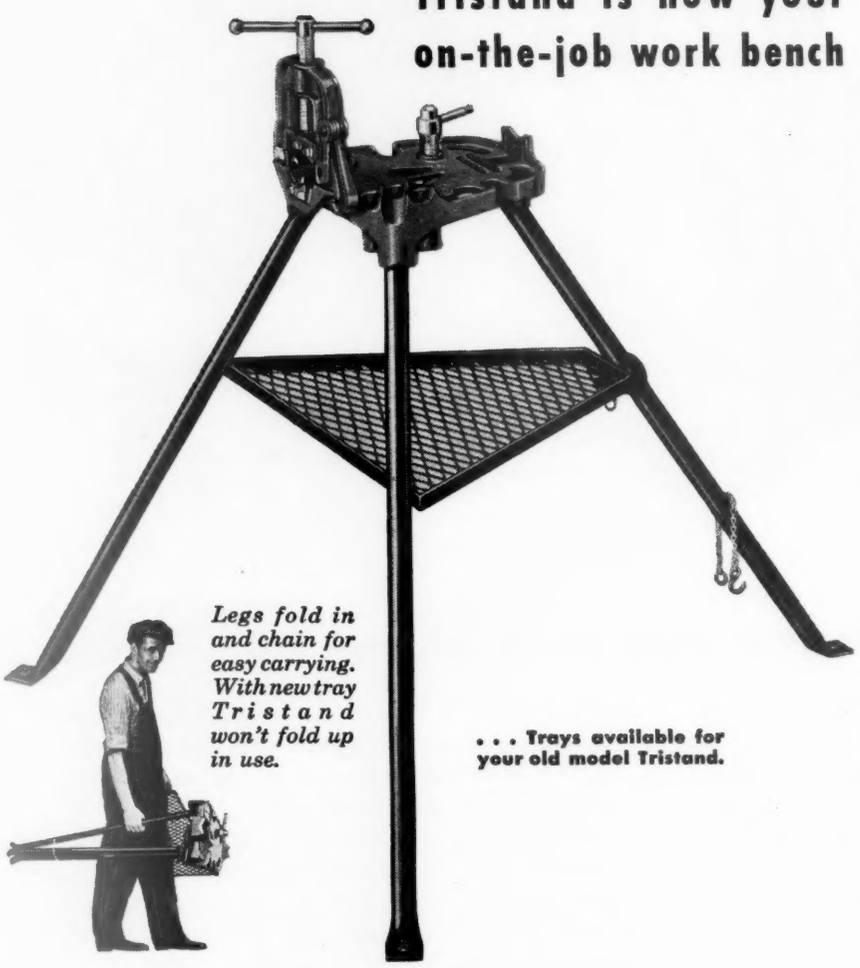
NEW TRISTAND VISE has Handy Tool Tray

RIDGID's New Tristand is now your on-the-job work bench



Legs fold in and chain for easy carrying. With new tray Tristand won't fold up in use.

. . . Trays available for your old model Tristand.

● All your tools are ready at hand, with this new RIDGID work-saver pipe vise. Tool tray keeps them in easy reach—eliminates stooping, speeds up work. New Tristand is easy to set up and take down, tray attaches in a jiffy. Legs have rubber feet to prevent "creeping." RIDGID's LonGrip tool-steel jaws have bulldog grip but are easy on polished pipe and tubing. Yoke vise, 2½" capacity; chain vise, 4." Buy the new work-saver RIDGID Tristand from your Supply House.

RIDGID

WORK-SAVER PIPE TOOLS

THE RIDGE TOOL CO. • ELYRIA, OHIO

LETTERS *to the Editors*

To The Petroleum Engineer:

Your article in the June issue of *The Petroleum Engineer* about Golden Spike field and Canadian developments was very interesting and shows clearly that Edmonton is the center of a real oil producing province. It sounds like a new West Texas.

Can you tell me whether or not there is much chance of finding employment in the exploration or drilling activities around Edmonton. Also, where can I find out more about the companies operating in that area, their headquarters, offices, etc.?

Harold Rice

Midland, Texas.

Editor's Note: You are right! The widespread discovery of rich reef-type oil fields in the Devonian limestone formations makes the Plains area of Alberta seem like a new West Texas. Drilling activity there may taper off, however, during the fall and winter due to the lack of outlet for the oil as well as the weather, which is very cold. Some rigs are reported to be stacked already. U. S. citizens are not permitted to obtain employment in Canada unless their prospective employer is able to show the authorities that no Canadian citizen with the same qualifications is available for hire.

The Western Canada Petroleum Association's secretary, E. W. Kolb, 309 Lancaster Building, Calgary, Canada, offers assistance to prospective employers in getting U. S. citizens cleared with the Canadian Immigration Service. Oil men can look things over on a tourist visa or permit, but must obtain clearance with the authorities before buying leases or selling goods or services.

James Richardson & Sons of Winnipeg, Canada, have published an interesting and informative booklet, "Western Canadian Oils," describing Canadian petroleum activity in detail. (See "Trade Literature," Page E-30.)

To The Petroleum Engineer:

Please forward to me four copies of your 'Petroleum Engineer' of April 1949.

I find that your presentation of the operations in the Gulf are the best of any publication I know.

C. H. Luby

Tidelands Surveying Company.

The Petroleum Engineer

JULY
1949

Report on the

Long-Term Availability of Petroleum*

Introduction

THIS report covers the results of a study of the amount of petroleum which can be expected to be available to this country for all purposes during the five-year period 1949-1953, inclusive, and a statement covering the supply during the years 1954-1959.

The study shows that petroleum liquids from natural sources will be available within the United States in substantially increasing amounts; that under favorable conditions there will be increasing amounts of petroleum readily available from other areas in both the Western and Eastern Hemispheres for importation into the United States if needed; and that there are abundant sources of raw materials within the United States from which petroleum products can be produced synthetically to supply all needs if it becomes necessary or advisable to produce them by this method. In short, this nation can continue to grow through the use of petroleum products as a major source of energy.

*By the Subcommittee on Long-Term Availability of the National Oil Policy Committee, American Petroleum Institute, November, 1948. The committee is composed of: L. F. McCollum, chairman, John R. Suman, vice chairman, Hines H. Baker (successor to H. C. Wiess, deceased August 26, 1948), R. G. Dunlop, R. G. Follis, Jake L. Hamon, B. A. Hardey, John M. Lovejoy, A. C. Mattei, N. C. McGowen, R. Ogarrio, A. W. Peake, S. A. Swensrud, A. E. Watts, L. S. Wescoat, Ralph T. Zook, and Minor S. Jameson, Jr., secretary.

The Study

The study is the most comprehensive undertaken by the oil industry in recent years. It was thorough and painstaking. More than 75 individuals were members of the subcommittee and its various working groups. Each group called upon those geologists and production technicians who had intimate knowledge of the area under study, with the result that several hundred trained personnel participated. Through these individuals and under the procedure followed, it was possible to obtain and consolidate a large portion of the industry's information on this subject.

In estimating future availability of oil for consumption in the United States, both the importance of the subject as well as the inherent difficulties of the undertaking have been recognized. Petroleum, being a natural resource contained in subsurface formations, must be discovered and developed before it can be produced and converted into the many oil products used by the consumer. The discovery of new underground reserves and the development of these newly discovered fields is the industry's major operation, carried on continuously. It is the most important single factor affecting the estimates of future petroleum availability. The estimates are based on the industry's ever-increasing store of knowledge as to the prospects for further discovery and development but, in the final analysis, the volume of newly discovered and developed oil cannot be determined accurately until the actual results of future drilling become available. It was felt, therefore, that it was both necessary and desirable to show a probable range within which future availability might be expected to fall. With this in mind and subject to the conditions set out in this report, it is believed that this study represents a reasonably reliable guide as to the probable availability of petroleum for consumption in the United States.

Petroleum products for consump-

Basic Data

This report, made by the Sub-Committee on Long-Term Availability of the National Oil Policy Commitee, American Petroleum Institute, discusses a timely and vital question that affects the entire structure of the oil industry. The Committee, headed by L. F. McCollum, has collected some pertinent information here that will be of interest to everybody in the petroleum industry.

tion in the United States may be obtained from three principal sources: 1, domestically produced crude petroleum and natural-gas liquids; 2, synthetic production from natural gas, oil shale, and coal; and 3, petroleum produced in foreign countries in both the Western and Eastern Hemispheres. All three sources have been considered in this survey, with detailed estimates being shown for the five years 1949-1953, inclusive. For the following five-year period 1954-1958, a more general analysis of probable availability has been made.

Basic Conditions

The results of the study should be considered in the light of the following basic conditions prevailing: that there will be favorable economic conditions; that there will be no government regulation of, or restrictions upon, the industry's normal activities; that adequate materials will be available to carry on the industry's contemplated operations; that estimated availability will be based on maximum efficient rates of production under engineering principles consonant with good conservation practices; and, that there will be no serious interruptions in the industry's activities in the event of war. Any substantial deviation from these conditions in actual developments during the 10-year period, due to matters outside the control of the industry, necessarily would require modification of the forecasted availabilities.

Conclusions

1. It is estimated that total availability of petroleum and petroleum products for consumption in the United States will increase substantially during the 10 years 1949-1958, inclusive.

2. During the five years 1949-1953, inclusive, the availability of natural liquid hydrocarbons (crude petroleum and natural-gas liquids) produced in the United States is estimated to increase as shown in the following tabulation:

	Probable Range		
	Lower (Barrels Daily)	Upper (Barrels Daily)	Average (Barrels Daily)
1949	6,120,000	6,300,000	6,210,000
1950	6,310,000	6,630,000	6,470,000
1951	6,460,000	6,920,000	6,690,000
1952	6,560,000	7,140,000	6,850,000
1953	6,600,000	7,320,000	6,960,000

For comparison, the actual domestic production of these liquids in 1948 is expected to approximate 5,900,000 bbl per day (5,500,000 bbl daily of crude petroleum and 400,000 bbl daily of natural-gas liquids). The estimated 1953 rates, therefore, would be equivalent to an increase over 1948 of 1,060,000 bbl daily on the basis of the average estimate of availability.

3. Supplementing the natural petroleum liquids produced in the United States during the next five years the estimated availability of petroleum products from synthetic processes, under foreseeable economic conditions, is relatively small, with the volume reaching approximately 30,000 bbl daily of oil products converted from natural gas by 1953. However, technically feasible and operable processes for the conversion of natural gas, oil shale, and coal to oil products have been developed, and large sources of supply of those raw materials exist.

4. Production of foreign petroleum is estimated to increase substantially during the five years 1949-1953, inclusive. Total estimated production of crude petroleum in the foreign nations of the Western Hemisphere (for use in those foreign nations and for export) is estimated to increase from 1,750,000 bbl daily in 1948 to 2,490,000 bbl per day in 1953, and in the Eastern Hemisphere (exclusive of Russia) from 1,500,000 bbl daily in 1948 to 2,520,000 bbl per day in 1953. Although it was beyond the scope of the study to estimate future distribution of this foreign oil between consuming areas of the world, these increases in total foreign production should increase the availability from these sources for consumption in the United States. In this connection, it is important to note that consumption within the principal foreign oil-producing countries is relatively small, and the largest part of the output of those countries is available for use in other areas.

5. For the second five-year period 1954-1958, adequate information on which to base detailed estimates of availability of natural liquid hydrocarbons produced in the United States will not be available for several years. From the best data now obtainable, no significant decline from the 1953 estimated rates is anticipated during following five years, but it is impossible to foresee definitely at this time the probable trends. However, as these trends become defined, and if a moderate decline in domestic output of natural liquid hydrocarbons should be indicated, supplementary sources of petroleum and its products are estimated to become available in larger volumes if needed. Large reserves of the raw materials for the synthetic production of oil exist in the form of natural gas, oil shale, and coal. Future availability from these sources may be considered to be limited primarily by the practical considerations of the need for such production and the time, materials, and capital required to construct necessary facilities. Under the conditions set forth in the report, the availability of petroleum produced in foreign countries in both the Western and Eastern Hemispheres is estimated to increase further during the second five-year period and provide additional supplementary supplies for consumption in the United States if needed.

6. Proved reserves of natural gas are at a relatively high ratio to consumption and, as distribution facilities are expanded, it is estimated that larger quantities of this fuel will be available to supplement liquid petroleum products in supplying the nation's energy requirements.

Estimated Availability

In estimating the availability of crude petroleum and natural-gas liquids produced in the United States, it was both necessary and desirable to consider a probable range within which this availablility may reasonably be expected to fall. Future availability can be measured only to the degree of accuracy that it is possible to measure the results of future operations in the search for, and development of, additional underground sources of supply. Within a limited future period, these results can be approximated. As the period is extended, the margin of error unavoidably increases due to a lack of the information that will later become available so as to permit a significant determination of the volume of oil found and developed. The following tabulations, therefore, show the estimates of future petroleum availability with an upper and lower range. The lower range may be considered as the minimum volume estimated to become available. The upper range represents the probable availability with more favorable results from exploratory and development activities, including unhampered leasing and development of the continental shelf. For comparison, figures are included for actual production (not availability) during the preceding 10 years, 1939-1948.

Domestic crude petroleum.

(In thousands of barrels daily)

Actual production (Per U. S. Bureau of Mines)	
1939	3,466
1940	3,697
1941	3,842
1942	3,799
1943	4,125
1944	4,584
1945	4,695
1946	4,751
1947	5,085
1948 (partly estimated)	5,500

Estimated availability	Average	Probable Range from Average	
		Lower	Upper
1949	5,760	5,670	5,850
1950	5,995	5,840	6,150
1951	6,190	5,970	6,410
1952	6,330	6,050	6,610
1953	6,425	6,080	6,770

In addition to the figures covering crude petroleum, supplies of petroleum products are derived from natural-gas liquids. The actual production of these liquids and the estimated future availability are shown in the following tabulation:

Domestic natural-gas liquids.

(In thousands of barrels daily)

Actual production (Per U. S. Bureau of Mines)	
1939	141*
1940	153*
1941	222
1942	228
1943	240
1944	273
1945	307
1946	316
1947	362
1948 (partly estimated)	400

Estimated availability	Average	Probable range from average: Lower	Upper
1949	450	450	450
1950	475	470	480
1951	500	490	510
1952	520	510	530
1953	535	520	550

*Does not include some cycle condensate included in subsequent years.

Combining the figures for crude petroleum and for natural-gas liquids gives the total volume of natural liquid hydrocarbons produced in the United States as shown hereinafter:

Total domestic crude petroleum and natural-gas liquids.

(In thousands of barrels daily)

Actual production (Per U. S. Bureau of Mines)	
1939	3,607
1940	3,850
1941	4,064
1942	4,027
1943	4,365
1944	4,857
1945	5,002
1946	5,067
1947	5,447
1948 (partly estimated)	5,900

Estimated availability	Average	Probable range from average: Lower	Upper
1949	6,210	6,120	6,300
1950	6,470	6,310	6,630
1951	6,690	6,460	6,920
1952	6,850	6,560	7,140
1953	6,960	6,600	7,320

As shown in the foregoing tabulations, the availability of liquid hydrocarbons (crude petroleum and natural-gas liquids) produced in the United States is estimated to increase during the five-year period 1949-1953. As compared with the 1948 production of crude petroleum and natural-gas liquids of 5,900,000 bbl daily, the average of the upper and lower range of estimated availability equals 6,960,000 bbl per day in 1953, an increase of 1,060,000 bbl daily over the 1948 production. The probable range in availability from this average figure of 6,960,000 bbl daily varies from a minimum of 6,600,000 bbl per day in 1953 to an upper figure of 7,320,000 bbl daily for that year. The lower range represents an increase of 700,000 bbl daily during the five years over 1948 production, whereas the upper range is equivalent to a 1,420,000-bbl-per-day increase over the 1948 output.

For the following five-year period 1954-1958, a lack of adequate information makes it impossible to present detailed estimates. Whether availability from natural sources within this country will be subject to a moderate decline, a maintenance of then existing levels, or a continuing increase after 1953 are questions that cannot be resolved at this time. In this connection, however, the study does not indicate any sharp or substantial decline in the availability of domestically produced crude petroleum and natural-gas liquids during the second five-year period. Also, in this connection, the availability of petroleum from alternative or supplementary sources of supply, as set out in following sections of this report, must be considered.

Synthetic Petroleum Liquids

For a very long time the oil industry has been looking to synthetic fuels as one means of augmenting the petroleum supply of this country. It is estimated that private industry has already spent in excess of $100,000,000 in the development of synthetic processes. The industry is continuing to spend funds at a rate in excess of $10,000,000 a year and, as increased needs for synthetics should be manifested, far larger amounts would be applied to this field.

Already, processes for the conversion of natural gas, coal, and oil shale to oil products have been developed which are technically feasible and operable. A commercial plant is now under construction to convert natural gas to oil. At the present state of the art, refined products from coal and from oil shale are somewhat more costly than for natural petroleum, but it is possible that continued research and development work over the next decade will lead to processes for producing such products from one or both of these materials as cheaply as from natural petroleum.

The proved gas reserves of the country were estimated at 166 trillion cubic feet at the beginning of this year, whereas production in 1947 was at a rate of only 5.6 trillion cubic feet per year, or a ratio of reserves to production of almost 30 to 1. With this high ratio and with the probability that the reserves will continue to increase for the next few years as they have in the past, it seems reasonable that an increasing volume of gas could be dedicated to the synthetics industry without interfering with other demands for natural gas. The oil-shale reserves are known to be in excess of the equivalent of 100 billion barrels of petroleum. The coal reserves are so great that any estimate of potential synthetics from this source would be too large to be of real significance. There would certainly be adequate coal to supply the oil requirements of this country for many generations to come.

Based on the present plans of the industry and on the basis of present economic conditions, it is estimated that availability from synthetic production during the five years 1949-1953, inclusive, will increase to approximately 30,000 bbl per day by the end of the period. This estimated production will be entirely from conversion of natural gas to oil. During the following five-year period 1954-1958, it is expected that synthetic production of petroleum products from natural gas will increase at an accelerated rate if needed, supplemented by a relatively small output from plants for the conversion of both oil shale and coal to oil.

In considering the foregoing outlook for synthetics, there is obviously a wide latitude for judgment because of the many conditions that might arise to change the conclusions significantly. Changes in the basic conditions, as set forth previously in this report, would have particularly important effects upon developments in the synthetic field. An additional factor bearing on this situation is the possibility of discovery of unexpectedly large new oil reserves.

Foreign Petroleum

Petroleum produced in foreign countries in both the Western and Eastern Hemispheres provides an additional source of supply for the United States, as a substantial portion of this foreign production has been developed and is being produced by American companies or their affiliates.

The following tabulation shows the total production of crude petroleum in foreign areas (excluding Russia) for the 10-year period 1939-1948 and the estimated production for the five years 1949-1953, inclusive:

Foreign crude petroleum.

	Western Hemisphere	Eastern Hemisphere (Exclusive of Russia)	Total Foreign (Exclusive of Russia)
Actual production	(In thousands of barrels daily)		
1939	914	713	1,627
1940	877	666	1,543
1941	989	584	1,573
1942	727	568	1,295
1943	823	673	1,496
1944	1,067	662	1,729
1945	1,256	719	1,975
1946	1,434	887	2,321
1947	1,592	1,061	2,653
1948 (mid-yr. estimate)	1,750	1,500	3,250
Estimated production			
1949	1,900	1,680	3,580
1950	2,060	1,840	3,900
1951	2,250	2,080	4,330
1952	2,450	2,260	4,710
1953	2,490	2,520	5,010

The foregoing figures do not include a relatively small volume of allied liquid hydrocarbons and synthetic production amounting to approximately 50,000 bbl daily in 1948 which is estimated to increase to about 70,000 bbl per day in 1953, approximately one-fourth of which is from the foreign Western Hemisphere and three-fourths from Eastern Hemisphere sources.

With regard to these figures on foreign production, it should be noted that they are total quantities for use in foreign countries as well as supplying the import requirements of the United States. World distribution of these supplies involves questions of estimated oil demands and political considerations beyond the scope of this study. However, certain observations may be made with relation to the availability of this foreign production for consumption in the United States.

Petroleum produced in foreign countries of the Western Hemisphere has been, and is being: 1, consumed in the foreign nations of the Western Hemisphere; 2, exported for consumption in the United States; and, 3, exported to Eastern Hemisphere countries to meet that hemisphere's deficiency in oil supply. Petroleum produced in the United States is also being supplied to meet a portion of the deficiency in Eastern Hemisphere output. An increased availability of foreign production for consumption in the United States may be expected as a result of increased Eastern Hemisphere production, making that area no longer dependent upon Western Hemisphere sources. To the extent that this may occur, it will obviously increase the availability of Western Hemisphere oil for use in the United States and other Western Hemisphere nations. In this connection it will be noted that the estimated production in the Eastern Hemisphere (excluding Russia) increases from 1,500,000 bbl daily in mid-1948 to 2,520,000 bbl per day in 1953, a rise of approximately 70 per cent in the five-year period. Foreign Western Hemisphere production is estimated to increase by about 40 per cent during this same period, from 1,750,000 bbl daily in 1948 to 2,490,000 bbl per day in 1953. Oil consumption in the principal foreign oil-producing countries is relatively small, with the largest part of the output in these countries being available for export.

For the second five-year period 1954-1959, foreign production is expected to continue to increase. In view of the large volume of proved reserves, production from Eastern Hemisphere sources may be expected to continue to increase at a faster rate than in the foreign Western Hemisphere.

In view of the assignment to study the supply of petroleum liquids, no estimates of the availability of natural gas have been prepared other than a consideration of that portion of the gas for conversion into liquid products. However, the relationship of natural gas to petroleum liquids is an important factor in the overall availability of fuels to supply the nation's energy requirements.

The three principal sources of energy in the United States are coal, oil, and natural gas—with water power playing a lesser rôle. For many uses, these three fuels are directly competitive.

As previously stated, the proved reserves of natural gas have increased steadily, and were estimated at approximately 166 trillion cubic feet at the beginning of the year 1948. These proved reserves are at the relatively high ratio of approximately 30 to 1 to present consumption, and there is no question that availability of this fuel at the producing wells considerably exceeds present distribution facilities. As distribution facilities are expanded, a larger and larger volume of natural gas will be made available to supply overall fuel needs in this country. To this degree, therefore, natural gas is closely related to the availability of liquid petroleum, and it represents a highly important supplementary source of fuel energy.

* * *

Petroleum Industry Plans Capital Outlay

The American petroleum industry has earmarked another two billion dollars for its 1949 expansion and modernization program—a new investment equal to $65 for each of the 33,000,000 passenger cars in the United States.

This was disclosed by William R. Boyd, Jr., president of the American Petroleum Institute, in announcing the results of an industry survey on capital investment plans for the current year.

Replies received to date from the questionnaire sent out by the API president represent a substantial portion of the industry. It revealed that the oil industry will make capital investments in excess of 2.1 billion dollars in 1949, to step up their facilities and their services to the millions of consumers. This sum is only slightly less than the outlay of 2.3 billion dollars which these same companies invested in 1948 to meet increased public demand for petroleum products.

The 2.1 billion dollar investment for the current year is equivalent to $14.50 for each of the 148,000,000 persons in the United States, or $53 for each of the 40,000,000 cars, trucks, and buses in the nation.

The petroleum industry, as it has done historically, will generate the major part of its financial requirements from its own operations. Private loans from banks and insurance companies will be utilized to make up the difference, and help underwrite the cost of these improved services for the public. In 1948—the peak year for capital investment—the industry plowed back 75 per cent of its earnings to finance its expansion plans.

In addition to the overall total of 2.1 billion dollars in direct capital investment, the nation's oil companies have budgeted more than $119,000,000 for intangible development. These funds are earmarked to pay for the proving and development of prospective oil fields when such costs are not capitalized and, in part, for losses sustained when wells fail to produce and are abandoned as dry holes. The investment in oil production this year, as in previous years, will account for more than 50 per cent of the industry's 1949 outlay. The cost of finding and developing a barrel of crude oil has increased since pre-war days, because the oil companies must drill more wells and deeper wells, and search in more remote places in their unceasing job of building up the nation's reserve pools.

Following is a summary of the capital investment questionnaire to date:

Year	Production	Refining	Transportation	Marketing	Other	Total	Intangible Development
1947	897,385,000	397,195,000	275,771,000	269,372,000	38,424,000	1,878,147,000	99,775,000
1948	1,223,320,000	588,012,000	264,273,000	209,078,000	70,350,000	2,355,033,000	135,485,000
1949	1,134,784,000	524,797,000	201,019,000	232,145,000	53,461,000	2,146,206,000	119,119,000

The Elk Basin Conservation Project*

L. R. LYON,† R. A. FEAGAN, JR.,† and H. B. MANLEY†

Introduction

In recent years the Rocky Mountain area has been the scene of intensive development by the oil industry. In Wyoming, a boom in oil activity occurred during the six years from 1942 to 1947, with 41 new fields discovered and 23 new producing horizons developed in old fields. At Elk Basin, oil has been produced for approximately 35 years, but it was not until the latter part of 1942 that oil was discovered in the combined Embar-Tensleep sands. With the increased crude oil demand of the last war, this reservoir, which lies partly in Montana, became the greatest producer in either of these two states.

A study of the Elk Basin field indicated that pressure maintenance would increase materially the ultimate production of crude from the Embar-Tensleep reservoir. Subsequently, in May, 1946, with the approval of the Secretary of the Interior, the 29 working interests unitized the Embar-Tensleep and all lower potential horizons and made Stanolind Oil and Gas Company the operator. The unit agreement provided that a development and operating program be established for the more proper conservation of the unitized substances, and a part of this program required the maintenance of reservoir pressure by the injection of natural or inert gas or water.

Detailed engineering study indicated that shrinkage of casinghead gas when processed by sweetening and compression would be so great that the residue gas alone would not provide adequate pressure maintenance. Since neither sufficient water nor outside gas were economically available, the injection of inert combustion gases from a boiler into the reservoir was considered the most favorable means of pressure maintenance. In September, 1946, the Embar-Tensleep operating committee of the Elk Basin unit authorized the preparation of engineering plans and specifications for a pressure maintenance plant. In June, 1947, the design was approved and construction authorized for a plant (1) to produce 14,000,000 scf[1] per day of boiler flue gas suitable for injection into the reservoir and (2) to process 12,000,000 scf per day of casinghead gas for the production of plant fuel and the recovery of liquid hydrocarbons and sulphur. Construction of the plant was started in September, 1947, and initial operations began in March, 1949. Stone and Webster Engineering Corporation was contractor for this job.

The Elk Basin plant, in addition to producing inert gas for injection into the reservoir and processing casinghead gas for recovery and utilization of the hydrocarbons, also produces sulphur. In most plants of this nature, hydrogen sulphide extracted during the sweetening operation is flared and vented to the atmosphere—a total loss. In the Elk Basin plant, this corrosive and toxic gas produces commercial sulphur, thereby further contributing to the conservation of Wyoming's natural resources.

A favorable factor in the recovery of sulphur at Elk Basin is the high content of hydrogen sulphide in the casinghead gas. At the time of discovery of the Embar-Tensleep reservoir, *this casinghead gas contained the highest concentration of hydrogen sulphide encountered in any known production.*[2]

FIELD SYSTEM

The Elk Basin oil field is located on the Montana-Wyoming border, 18 miles north of Powell, Wyoming. The major part of the field is in Park County, Wyoming, with a portion extending into Carbon County, Montana. The field appears to be an anticlinal trap with several producing formations. Prior to the Embar-Tensleep development, light production was realized from the Frontier and Dakota (gas) formations. Recently, completions have been made in the Madison lime, which is below the Embar-Tensleep and to date the deepest producing formation in the field.

In 1948, the Elk Basin field produced about 7,200,000 bbl of oil, of which about 6,000,000 bbl was Embar-Tensleep crude.

The Embar-Tensleep now produces

[1]Scf=Standard cubic feet (60 F—760 m.m.).
[2]Italics ours.—Ed.

FIG. 1A. Feed gas, design basis, Elk Basin plant.

Components	Mol. %	MSCFD
Nitrogen	2.00	240
Carbon dioxide	6.00	720
Hydrogen sulphide	18.50	2,220
Methane	41.75	5,010
Ethane	15.50	1,860
Propane	7.41	889
Butanes	5.20	624
Pentanes and heavier	3.64	437
Total	100.00	12,000

FIG. 1-B. Products, design basis, Elk Basin plant.

Propane	19,100 gal per day
Butane	20,200 gal per day
Natural gasoline	16,900 gal per day
Sales gas at 500 psig	4,200,000 scf per day*
Inert gas at 1500 psig	14,000,000 scf per day
Sulphur	74 long tons per day

*Includes inert gas dilution to 1000 btu per scf (dry).

*Presented before the Rocky Mountain Division meeting of API, Casper, Wyoming, May 27, 1949.

†Stanolind Oil and Gas Company, Tulsa, Oklahoma.

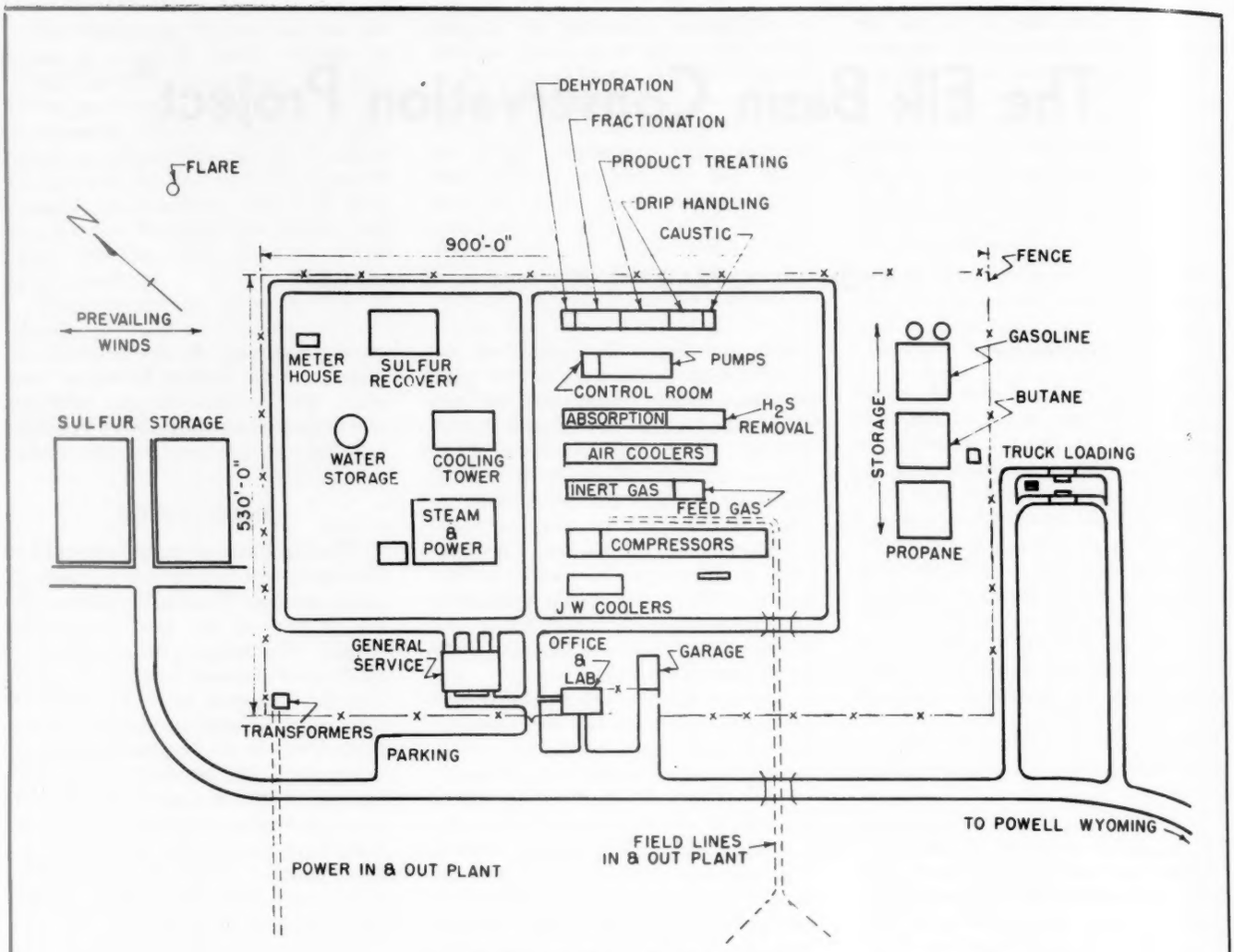


FIG. 2. Plot Plan—Elk Basin Plant.

from 124 wells ranging in depth from 3900 to 6000 ft. Casinghead gas is collected from elevated separators at nine consolidated crude oil tank batteries in the field. The gas collection system is installed above ground on wooden ties and consists of about 10 miles of pipe ranging from 6 in. to 22 in. in diameter. The collection system, consisting of two main lines, one from the north part of the field, the other from the south, is sized to deliver gas to the plant compressors at a pressure slightly above atmospheric, with field separators operated at 2 psig. Vacuum operation is avoided, in order to prevent possible air infiltration and thereby minimize potential corrosion by hydrogen sulphide. The gas collection system is designed with a minimum number of low spots as trap and accumulation points for line condensate or drips. These low points are equipped with underground drip collection tanks from which pumps, controlled by float operated switches, deliver the condensate to a surge tank at the plant. There are six such collection points from which small pipe lines run to the plant paralleling the gas collection system.

Package units for dehydrating casinghead gas at the field batteries have been included in the design but as yet have not been installed. It is planned to determine by operating experience whether it will be necessary to dehydrate the gas in order to prevent freeze-up of the gas collection system during extreme cold weather.

The field injection system delivers inert gas from a plant pressure of 1500 psig to four wells in the south part of the field and four wells in the north part. The lines are underground and range in size from 2 in. to 6 in. in diameter.

ELK BASIN PLANT

General

The plant design provides for the extraction of H_2S, CO_2, gasoline, butane, and most of the propane from 12,000,000 scf per day of casinghead gas, producing a fuel gas suitable for plant boilers and compressors a residue gas in salable form at 500 psig, commercial sulphur and non-corrosive boiler flue gas at 1500 psig for injection into the Embar-Tensleep reservoir.

As may be seen from Fig. 1-A, the sweetening of the field gas by removal of H_2S and CO_2 leaves a gas rich in propane and heavier hydrocarbons. For recovery of these hydrocarbons, a number of process cycles were studied. The absorption cycle selected consists of a single inter-cooled high pressure absorber followed by (1) a reboiled absorber (demethanizer) operating at a lower pressure for partial stabilization of the rich oil, and (2) a single still for stripping the heavier absorbed hydrocarbons from the absorption oil. A study of plant and field conditions indicated that the plant should be designed for 80 per cent propane recovery. Design product quantities are tabulated in Fig. 1-B.

In conjunction with the preparation of inert gas, a steam power plant is provided to produce steam and electricity for the plant and part of the electric power required by the field. Additional electric power required for the field and standby for the plant is purchased from outside sources. Boiler flue gas is dehydrated and compressed to 1500 psig for injection.

Water for the plant, available from the system that was installed during the development of the reservoir, is pumped from the Clark's Fork River, which is approximately 15 miles west of the field in the Absaroka foothills. Since plant make-up water is limited by this system to 5000 bbl per day and because air temperatures are quite low in this region, a large portion of the cooling is accomplished by air-cooled units.

Design of the cooling equipment is based upon an 80-85 F dry bulb temperature and a 60 F wet bulb temperature.

The plant is located on the east side of the mid-portion of the field, and has a general layout to conform with the terrain. Arrangement of the plot plan is shown in Fig. 2. The plant has been separated into two areas with one portion containing all of the fired equipment and the other portion containing all hydrocarbon processing equipment. The long axis of the plant is roughly from northwest to southeast to take advantage of prevailing winds for cooling purposes and to minimize snow accumulation.

Most of the plant processing equipment is outdoors, but buildings have been provided to house pumps, compressors, generators, and boilers. In addition, there is a main office and laboratory building, a loading rack ticket house, a garage, and a general service building. Also, a building has been provided to house certain of the sulphur recovery equipment.

Product shipment from the plant is by truck. Rail facilities are provided at Powell, Wyoming, for trans-shipment of lump sulphur.

Field Gas Compressors

The plant field gas compressors (Fig. 3) consist of three 3-stage 1000 hp (sea level rating) 2 cycle, right angle, gas engine driven units designed to compress a total of 12,000,000 scf per day from 12.7 psia to 540 psia. Because of the 4962-ft altitude, these compressors are de-rated to approximately 860 hp each.

Field gas enters the plant through a scrubber designed to remove entrained crude oil, scale, and other foreign materials. Gas from this scrubber flows to the first stage suction header at 0.5 psig and is compressed in the first stage of compression to 46 psig. The first stage discharge gas is cooled, passed through a separator and sent to the low pressure amine absorber where it is partially stripped by hydrogen sulphide and almost completely stripped of carbon dioxide. The gas is then further compressed to 152 psig in the second stage, cooled, passed through a separator, and treated in the high pressure amine absorber for hydrogen sulphide removal to a maximum residual concentration of 0.25 grains H_2S per 100 scf. The sweet gas is then compressed in the third stage to 525 psig, passed through the third stage aftercooler and charged to the main absorber.

One of the inert gas injection compressors is manifolded to serve as a spare for the field gas compressors.

H_2S Removal System

A flow diagram of the H_2S removal system is indicated in Fig. 4. Because of the high acid gas (H_2S and CO_2) content, it was found desirable to use a 2-stage amine process for sweetening. This system removes hydrogen sulphide and carbon dioxide from the field gas by contact with a water solution of monoethanolamine in 21-tray contactors or absorbers installed at the discharge of the first (46 psig) and second (152 psig) stages of compression.

The first stage amine absorber reduces the hydrogen sulphide content to approximately 100 grains per 100 scf and the second or final clean-up stage produces a gas which will pass the lead acetate test. The rich amine solution with its load of acid gas is pumped through heat exchangers to the reactivator where the H_2S and CO_2 are stripped from the solution by steam vapors generated in the reboilers. The reboilers are heated with extraction steam from the power plant.

For better heat economy, a "split-flow" amine system is used. About half of the rich amine enters at the top of the packed reactivator and the remainder enters at the mid-point of the tower. A stream of partially stripped or semi-lean solution, withdrawn immediately above the middle of the reactivator, exchanges heat with the feed, and is pumped through coolers to the low pressure absorber, entering the fifteenth tray from the bottom. The completely stripped or lean solution, from the bottom of the reactivator, exchanges heat with the feed and is pumped through a cooler. From the cooler, this steam splits, half entering the high pressure absorber on the

FIG. 3. Compression-drips

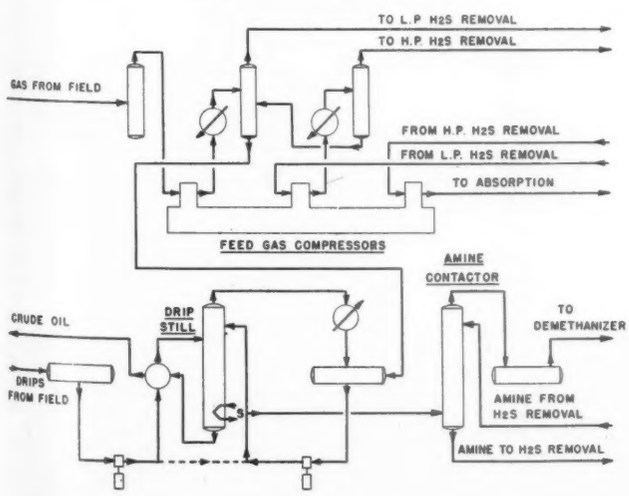
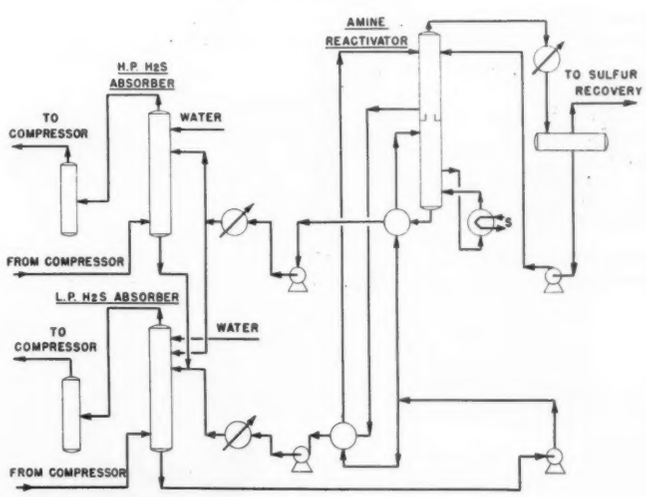
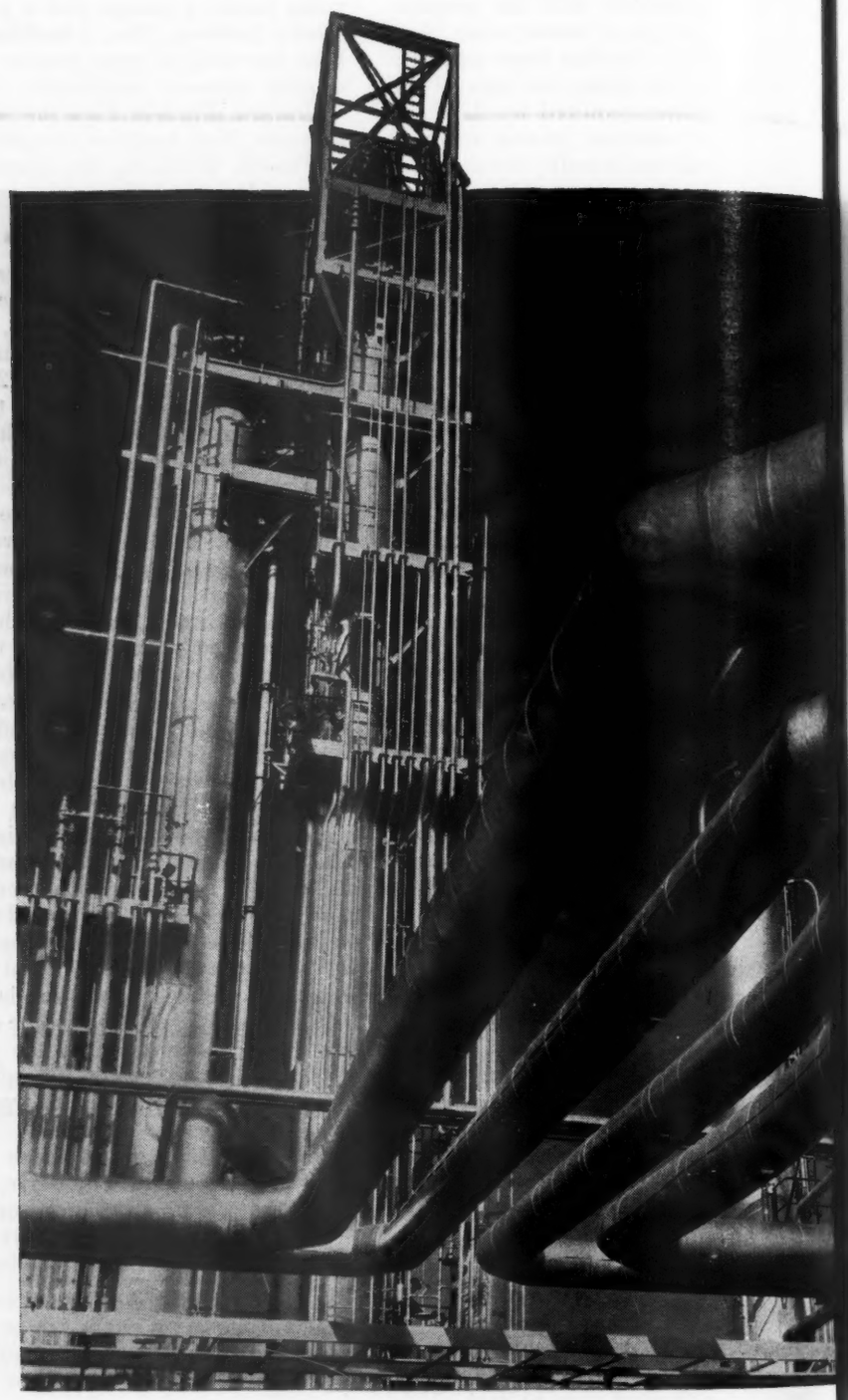


FIG. 4. H_2S removal.



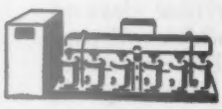
YOU CAN BE **SURE**.. IF IT'S

Westinghouse

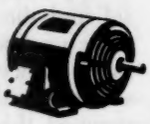


Turbines

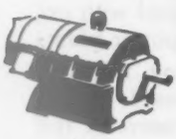
Turbo Generators



Ignitron Rectifiers

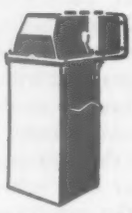


A. C. Motors



Gear Motors

Speed Reducers

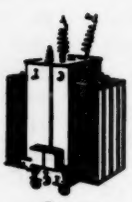


Corrosion Resisting Motor Control

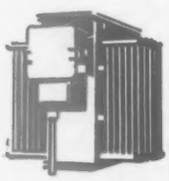
Circuit Breakers for Hazardous Locations

Disconnecting Switches

Instruments



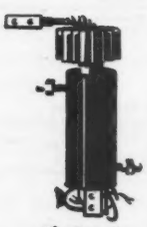
Power Transformers



Distribution Transformers and Switchgear

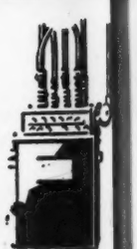
Capacitors

Industrial Lighting



Electronic Tubes

Oil Immersed Pushbuttons



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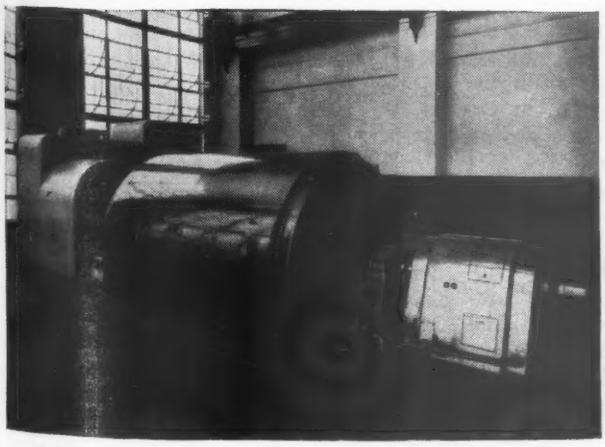
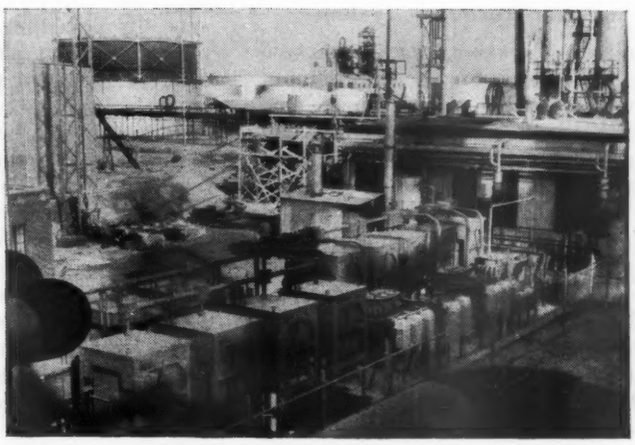


This Westinghouse 7500-kva turbogenerator is installed in a large refinery power plant. Where utility power is not available in sufficient quantities for a large refinery, units of this type provide an economical source of power.



The use of Westinghouse oil-immersed equipment suitable for hazardous and corrosive atmospheres made it possible to locate this motor control and distribution center near the loads, thus reducing length of individual circuit runs.

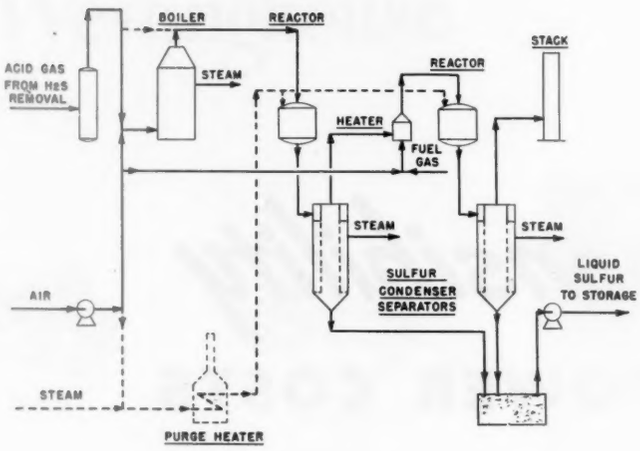


FIG. 5. Sulphur recovery.

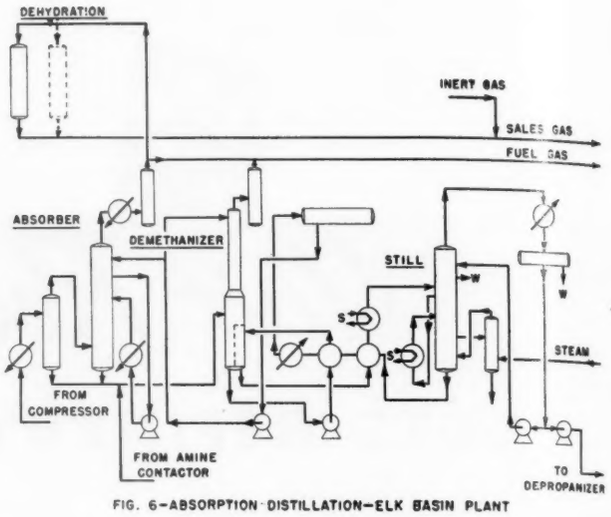


FIG. 6-ABSORPTION-DISTILLATION-ELK BASIN PLANT

FIG. 6. Absorption distillation.

nineteenth tray and half entering the low pressure absorber on the eighteenth tray from the bottom. The rich solution from the bottom of the high pressure absorber, having a relatively low acid gas content, is added with the semi-lean solution to the low pressure absorber. A water wash stream from the discharge of the reactivator reflux pump enters the top (21) tray of the low pressure absorber, and a separate water wash stream, stripped of acid gas, enters the top (21) tray of the high pressure absorber, thus minimizing amine loss to the gas streams. Splitting the flow of the rich and lean solution streams in the above manner results in a reduction of reactivation heating and cooling loads.

Overhead vapor from the reactivator is cooled to approximately 115 F; the condensed water is pumped back to the tower as reflux and the acid gas flows to the sulphur recovery unit.

The process design for the H_2S removal system was developed by the Girdler Corporation.

Sulphur Recovery System

Sulphur has several rather unusual properties which must be kept in mind when considering the design of the sulphur recovery system. At room temperature the stable crystalline form of sulphur is rhombic, at about 200 F a solid transition to the monoclinic form occurs, and sulphur melts at approximately 240 F. At the melting point, sulphur is a straw-colored liquid of low viscosity, and as the temperature is increased the viscosity decreases slightly up to a temperature of about 320 F. With further heating, the viscosity rapidly increases from about 40 centipoises at 320 F to more than 2000 centipoises in the region of 400 F and then decreases again as the temperature rises above 400 F. Thus, at 320 F sulphur is easily handled as a liquid in pumps and plant piping, but at 400 F it is a heavy plastic material.

Design of the Elk Basin sulphur recovery system is based on a modification of the Claus process. Variations of this process have been used for a number of years in Europe but only recently has it been commercially developed in the United States.

In the Elk Basin plant, acid gas from the amine unit, containing approximately 75 per cent H_2S and 25 per cent CO_2, enters the sulphur recovery unit through a scrubber which removes entrained water. (Fig. 5.) Part of the acid gas from the inlet scrubber is burned with controlled air in a specially designed boiler to produce sulphur dioxide, utilizing the heat of combustion to generate 200 psig saturated steam. The combustion chamber of the boiler is operated at a pressure sufficiently high (about 3 psig) to force the combustion products through the remainder of the process without blowers or compressors. Combustion products from the boiler, containing sulphur dioxide, are co-mingled with the unburned portion of the acid gas and pass to the first reactor, which contains a bauxite catalyst. The design inlet temperature of the reactor is 450 F. Reduction of sulphur dioxide and oxidation of hydrogen sulphide occurs over the catalyst, releasing elemental sulphur. The heat of reaction raises the temperature to approximately 740 F, and at reactor exit conditions the sulphur is in the vapor state.

The reactor effluent gases are cooled to approximately 300 F in a condenser-separator which condenses the sulphur vapor and generates low pressure steam at approximately 35 psig. Reaction is not completely effected in one reactor, therefore, the remaining unreacted gases are reheated above the sulphur dewpoint to a temperature of 450 F in a gas fired line-heater and pass to a second and final reactor where the reaction proceeds substantially to completion. The exit gas from the second reactor flows to a second condenser-separator where the sulphur vapor is condensed at about 300 F. The non-condensed gas, which should contain less than 1 per cent H_2S, is exhausted to the atmosphere.

The condensed liquid sulphur flows from the conical bottoms of both condenser-separators to a surge tank and is pumped to storage through a steam jacketed line.

A small auxiliary heater is provided to burn any potential accumulation of carbonaceous materials from the catalyst beds. This unit also serves as a start-up heater.

The important combustion reaction is:

$$H_2S + 3/2\ O_2 = H_2O + SO_2$$

The reaction over the catalyst is:

$$2H_2S + SO_2 = 2H_2O + 3\ S$$

The reactors are Lumnite-lined cylindrical vessels, about 16 ft in diameter, with 6 ft catalyst beds. Gas flow is downward through the 4-8 mesh bauxite catalyst, with a design space velocity of roughly 250 scf per cf catalyst per hour. The catalyst bed is supported by a stainless steel grating and wire mesh. To minimize corrosion, an alloy of 18-8 stainless steel is used in the effluent piping from the reactors and for lining the inlet channels of the condenser-separators.

Absorption and Distillation System

The gas from the third stage of the field gas compressors enters the main absorber (Fig. 6) where approximately 90 per cent of the propane and substantially all heavier hydrocarbon components are extracted by the absorption oil at a pressure of 520 psig. The design oil rate to the absorber is 98 gpm. One intercooler is used to limit the overall temperature rise of the oil to 20 F, thus reducing the required oil circulation rate.

Rich oil from the absorber, together with treated compressor condensate and drip gasoline, enters the fourteenth tray of the demethanizer, which is operated at a pressure of 163 psig. Part of the lighter absorbed hydrocarbons flash and rise through the tower, while the remaining rich oil flows down through the fourteenth-tray stripping section of the tower to the reboiler. In the stripping section, vapors from the reboiler remove methane and some ethane from the rich oil. These vapors, along the flashed vapor from the feed, enter the twenty-fourth-tray absorption section where the propane loss to the residue gas is controlled by introduction of lean oil to the tray at a design rate of 40 gpm.

The reboiler receives heat by exchange with hot lean oil from the still. The bottoms from the demethanizer, containing a small quantity of ethane, 80 per cent of the propane, and essentially all of the butane and heavier components originally contained in the plant feed gas, flow through an exchanger and preheater to the still.

The residue gas from the main absorber (except that quantity used for fuel) is cooled, and dehydrated in a solid desiccant dehydration unit to meet sales gas specifications. Inert gas may be added to control the heating value at 1000 btu per scf before delivery for sale at 500 psig. Residue gas from the demethanizer, augmented by the required quantity of residue gas from the main absorber, is used as plant fuel.

The absorbed hydrocarbons are separated from the lean oil by steam stripping at 110 psig in a 20-tray still. The design stripping steam requirement is 2920 lb per hour.

Heat is added to the still by a reheater which utilizes 400 lb steam. The stripped lean oil flows through a heat exchanger, the demethanizer reboiler, and coolers to the lean oil surge tank from which pumps return the oil to the main absorber and the demethanizer. The hydrocarbons stripped from the oil in the still are condensed as an overhead product, the end-point being controlled by reflux pumped back to the top tray. Normally, there will be no uncondensed vapors from the still accumulator because of the removal of methane and a large part of the ethane in the demethanizer.

Fractionation System

The unstabilized gasoline from the still accumulator is pumped to the depropanizer (Fig. 7) which operates at about 310 psig. The liquid overhead product from the depropanizer, a mixture of ethane and propane, is fractionated in the deethanizer, which operates at 540 psig to yield commercial propane as a bottom product and ethane-propane vapor overhead. The latter may be recycled through the main absorber to recover the small amount of propane it contains, or sent to the main absorber residue scrubber where it joins the residue gas going to the fuel or sales gas system.

Partially stabilized gasoline from the bottom of the depropanizer is treated with caustic for mercaptan removal and flows to the debutanizer, operating at 110 psig. The overhead from the debutanizer is condensed and the liquid butane product flows to storage through a cooler. The controlled vapor pressure natural gasoline from the bottom of the debutanizer is cooled, sweetened, and pumped to storage.

The depropanizer and debutanizer are so designed that various product specifications may be met. The debutanizer may produce commercially pure butane or an LPG product which may have a maximum vapor pressure of 100 psig at 100 F and contain all the recovered butane. It is also possible to produce a natural gasoline ranging from debutanized to 26 lb RVP gasoline as a bottom product from the debutanizer.

Liquid Product Treating

The propane product is treated in a single-stage non-regenerative caustic contactor for removal of any H_2S which may have escaped the amine unit, dehydrated over the bauxite and then delivered to storage.

The high mercaptan sulphur content of the Embar-Tensleep gas makes it impractical to treat the gasoline in a conventional fixed bed copper chloride treater without a pre-treatment to reduce the mercaptan content, therefore, the combined butane and gasoline product of the depropanizer flows to a packed caustic contactor for removal of lower molecular weight mercaptans and traces of hydrogen sulphide. Spent caustic from the bottom of the contactor is regenerated by steam stripping in a packed tower.

Final sweetening of the natural gasoline produce from the bottom of

FIG. 7. Fractionation—product treating.

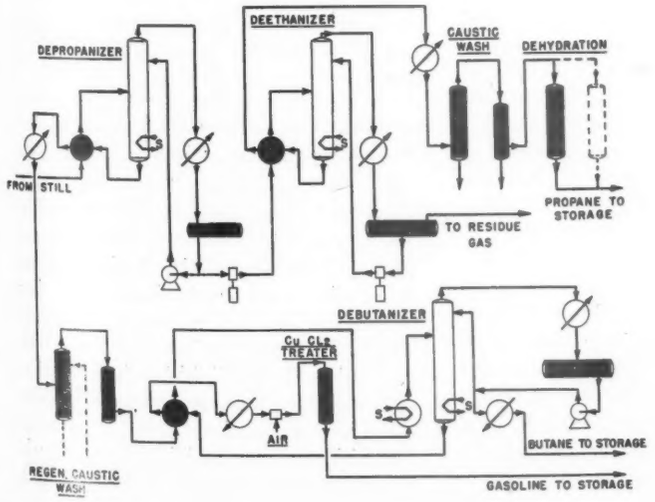
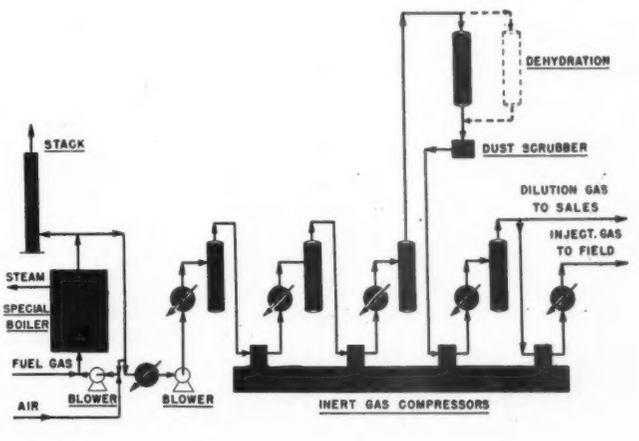


FIG. 8. Inert gas system.



the debutanizer is accomplished in a fixed bed copper chloride treater.

Drips Handling

Drips formed by condensation in the gas collection system during cold weather and at night are pumped into a surge tank in the plant (Fig. 3). The drips are pumped from the surge tank through an amine contactor for removal of hydrogen sulphide and then join the rich oil feed to the demethanizer. Lean amine from the hydrogen sulphide removal system is charged to the contactor and rich amine is returned for regeneration.

If crude oil is present, the drips may be charged to the drips still to prevent contamination of the absorption oil. The drips still operates at 18 psig and is designed to handle 5000 gal per day. A gasoline fraction is produced as an overhead product and pumped through the amine contactor to the demethanizer. The heavy bottoms product flows to the heavy oil slop tank.

Inert Gas Generation and Injection System

One of the Elk Basin plant boilers is designed for inert gas generation. It is equipped for close combustion control in order to operate the boiler with a small amount of carbon monoxide and no oxygen in the flue gas. Presence of oxygen is avoided throughout the inert gas system in order to prevent oxidation of the H_2S in the reservoir and possible plugging of the injection wells with elemental sulphur.

The combustion chamber of the boiler is enclosed in a gas-tight steel casing in which cool flue gas is circulated for cooling the boiler setting and preventing air infiltration. With vacuum operation avoided throughout the system in order to prevent air infiltration, the combustion chamber is operated at a positive pressure of 4 in. to 6 in. of water. An economizer reduces flue gas outlet temperature to about 400 F. A booster blower delivers the inert gas through coolers to the injection compressors at about 0.5 psig. Water condensed from the flue gas may be recovered and pumped to the cooling tower basin or boiler feed-water.

There are five 4-stage, 1200 hp (sea level rating), 2 cycle, right angle, gas engine driven injection compressors designed to compress a total of 15,000,000 scf per day of inert gas from 12.85 psia to 1525 psia. The design provides that 1,000,000 scf per day of inert gas be withdrawn from third stage discharge for sales gas dilution to reduce the heating value of the sales gas to 100 Btu per scf.

The inert gas is delivered by the four stages of compression through interstage coolers and scrubbers to the field injection piping system at 1500 psig and 165 F. Between the second and third stages (130 psig) of compression a solid desiccant unit dehydrates the injection gas, thereby eliminating potential corrosion.

Utilities

The design of the steam generation plant is based primarily upon the production of inert gas. In generating the inert gas, the special boiler delivers 52,000 lb per hr of superheated steam at 440 psig and 650 F. A conventional boiler provides an additional capacity of 55,000 lb per hr of steam at the same conditions for stand-by operation, but it normally operates at greatly reduced load for electric power generation. A consideration of steam and power requirements, particularly the large demand for low pressure process steam, indicated that turbo-generation of electric power would be more economical than gas engine generation. Consequently, high pressure superheated steam is used to operate two 1000 kw generators driven by turbines of the extraction type and delivering 35 psig process steam at extraction. The turbines exhaust at a condenser pressure of 6 in. of mercury absolute in winter and 25 in. of mercury absolute in summer. Additional 35 lb process steam is supplied by exhaust steam from turbines driving the 470 hp combustion air blower and the 550 hp inert gas blower.

Boiler make-up water is supplied by an evaporator. Since water is at a premium, oily condensate from the process area is passed through a chemical oil separator and returned to boiler feed. All return condensate and make-up water is deaerated in a spray type feed water heater.

An 8500 bbl tank is provided for water storage. The induced draft cooling tower is designed to cool 4000 gpm from 88 F to 68 F. Cooling tower make-up water from the Clark's Fork River is treated with sulphuric acid and stabilized with a corrosion inhibitor.

The two turbo-generators develop electric power at 2400 volts for the plant and the field. Power is distributed to central locations in the plant at 2400 volts and then reduced to 440 and 110 volts. Power from the generators, supplemented by outside facilities, is transformed to 7200 volts for transmission to the oil field.

A 50 psig plant fuel gas system utilizing residue gas from the demethanizer and absorber provides fuel gas for the compressors and boilers. Plant fuel gas is not dehydrated.

☆ ☆ ☆

Safety programs have always been a part of the oil industry's progressiveness. To show their effectiveness, one east coast refinery recently completed two million man-hours of work without a lost-time accident.

Storage Facilities

Approximately ten days storage for each of the liquid products is provided by 10 ft by 60 ft horizontal cylindrical tanks adjacent to the process area. Loading pumps transfer the liquid products to a two-spot truck loading rack. A suitable ticket house is provided. Two 500 bbl vertical tanks provide storage for absorption oil and heavy slop oil. A pump is installed to transfer absorption oil to and from the storage tank. Also, a re-run pump is provided to pump any off-specification product back to the distillation system.

Several methods were considered for the handling and storage of sulphur. One of these was the use of a belt conveyor for atmospheric cooling and solidification, the sulphur being broken off in flakes at the end of the belt. The efficiency of this technique is attractive for long-time operation but the possibility of a market for liquid sulphur in the near future has resulted in selection of the simplest and least expensive method for initial operations.

Molten sulphur from the sulphur extraction unit is delivered through a steam jacketed line to the sulphur storage area. There, the sulphur is discharged into a temporary sheet-metal vat where it solidifies by atmospheric cooling. The sheet-metal walls of the vat are raised as the sulphur hardens. When desired, the sheet-metal is removed and the solid cake of sulphur is blasted, loaded into trucks and hauled to a rail siding at Powell, Wyoming, where convevors are provided for intermittent loading into boxcars.

Conclusion

It is believed that the Elk Basin plant is an outstanding example of modern conservation practice. The project provides not only for recovery and utilization of the hydrocarbons from the sour casinghead gas, but also provides for pressure maintenance of the Embar-Tensleep reservoir in the Elk Basin Field by the injection of special boiler flue gas and the production of sulphur from hydrogen sulphide, a gas which is commonly flared in such plants. ★ ★ ★

The Future of Oil Refining*

CHESTER F. SMITH

IT gives me a great deal of pleasure to greet all of you at this mid-year meeting of the division of refining. Although I have attended meetings of the division for a good many years, this is my first official appearance as vice president for refining, and I assure you that I appreciate the honor of heading the activities of this section of the Institute.

In anticipating this occasion, I found it quite a problem to know what I could discuss and which might be worth the time of people who represent such a wealth of experience in the refining field as this group does. But it seemed that the one thing which probably is of most interest to us today is the changing pattern in the demand for the products which we make. And of extremely practical concern, surely, are the changes which this may compel in refining technology. I would like to talk with you, therefore, about some of the directions which those changes are taking or may take, as I see them.

In my opinion, the API will have a great deal to do with achieving the new goals, just as it has been a strong influence for progress in the past. The division of refining, providing as it does a forum for exchanging ideas on problems which concern our business, should continue to work in the field in which we all have common interests and a common goal. The open meetings are valuable, but of even more importance is the work of the committees—work that I'm afraid often is unnoticed and is seldom rewarded.

If the refining division can contribute even more effectively than it has in the past, we here should find ways to do so. The broad objectives of the API—and the more narrow ones of our own division—deserve a new postwar analysis. The recent action of the API board of directors, authorizing a special study of all Institute activities, is an opportunity for all of us to reexamine what we are trying to do.

I for one am convinced that this division can and will play an important part by continuing its very free and open forums and its committee work. But I welcome the opportunity which the board action gives us to sit back for a moment and figure out in some detail just where we are going.

I should also like to make some comment about the recent accomplishments of the refining branch of the industry. Until just a few months ago, the post-war years have been loud with threats of petroleum shortages. In disposing of those threats, the producers perhaps have enjoyed chief credit in the eyes of the public. They earned all the credit they received, however, great credit is also due the transporters, the marketers, and every other branch of the industry. In a continuous-flow industry like ours there can be no interruption at any point.

But I wonder how many people realize the size of the job that the nation's refiners were able to do in the emergency. The rapidly rising over-all demand and, in addition, the unexpected and radical shift in the proportions of the major products desired by consumers, brought headaches and heartaches.

To meet their responsibilities, the refiners stretched the capacities of existing units far beyond what anyone thought could be done. I have heard of some of the units being operated at almost three times their design capacity. Generally speaking, I suppose nearly every refinery in the country broke all existing on-stream records.

In spite of limited availability of steel and other materials, a huge refinery construction program was launched. More than five hundred million dollars was spent in 1948 alone for refining facilities. From the end of the war to the first of this year, more than a million barrels of new refining capacity has been built. Another two hundred thousand barrels a day will be completed by the end of 1949.

As in every branch of the industry, the refiners accepted the challenge and won the fight. Great credit must be given the 157,000 refinery employees for their part in this great success. The job could not have been done without their skill, diligence and loyalty. Nor could it have been accomplished without large investments, boldly and speedily made.

Looking ahead today, we have the satisfaction of knowing that our inventories have been rebuilt. Present indications are that we can keep ahead of demand, and do it without the improvising and straining which have been necessary during the past two years. Now each of us has an opportunity to survey the situations ahead of him—to plan how research and refining technology can best help his company to proceed on the progressive course which the industry has travelled in the past.

Fundamental in the thinking of all of us, I suppose, is that every oil company will strive to offer the public as constant an improvement in product quality as new equipment requires and as scientific advances and capital availability will permit.

In addition, every company will endeavor to supply adequate quantities of individual products at whatever rate the consumer may desire. With the changing patterns of demand which seem to lie ahead for the industry, we will have to continue to lean heavily on technology to help solve our problems.

Unless a basic change in automobile engine design, such as direct injection, should come along, anti-knock qualities of motor gasoline will probably continue upward in order to give motorists the economy and performance of already-developed higher compression engines. One of the important steps we will probably have to take to meet this requirement is the improvement and more extensive use of methods to increase the anti-knock rating of straight-run gasolines, because it looks as though we will have a lower proportion of cracked gasolines to work with. Refining technology will determine how this may best be accomplished.

The purpose of higher knock-rating is, of course, higher efficiency in gasoline use. From the standpoint of the motorist, the performance gain of his car, which may increase from 20 to 40 per cent, must not be wiped out by an excessive increase in the cost of his fuel. Anti-knock quality must be improved, therefore, without too large an increase in investment and operating cost, if there is to be an overall conservation gain.

*An address before the American Petroleum Institute, Division of Refining, Houston, Texas, April 6, 1949, by Chester F. Smith, vice president, Standard Oil Company (N. J.).

Demand will continue to increase for aviation gasolines of very high octane number for both military and commercial use. But the rate of increase should be slower than it has been, and available methods of manufacture would appear to be adequate for some time.

Here the question of jet engines and jet fuels enters as a potentially important factor. The ultimate demand for this fuel is difficult to forecast, but the extent to which jet propulsion—and also gas turbines—are developed is bound to affect the demand for conventional aviation gasolines, and could reduce it substantially.

Until a few weeks ago we were concerned about the refining problem of supplying large quantities of jet fuels in the range of the middle distillates. Now, with the new specifications for what is essentially a very low octane gasoline, it would appear that our manufacturing problems are simpler.

I have begun this discussion by talking about gasoline. Most of us would probably agree that, for the long term, the greatest single problem which confronts us is the potential increase in the demand for the middle distillates. However, gasoline will be the product of most concern for at least the next six months.

Gasoline demands are continuing to increase substantially. As much or more gasoline will have to be produced this summer than last, in spite of the current high stocks. And most important, this will have to be accomplished with crude runs somewhat lower than last year because of the high inventories of middle distillates and residual fuel oil, and the decreased demand at this season for these products.

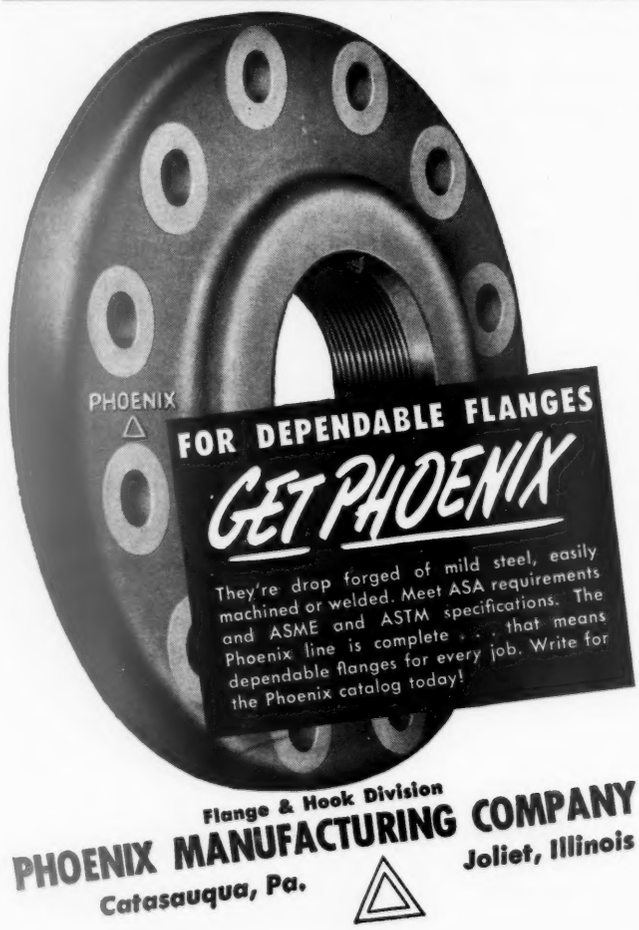
In other words, then, if we are to do this—produce as much or more gasoline with lower crude runs—the gasoline yield from crude will have to remain high this summer, reversing what was apparently a trend to lower gasoline yields. This condition will be only temporary, however, it seems to me. In the long run the anticipated growth in the demand for middle distillate products at a higher rate than the expected gain for gasoline demand ought to cause a decline in gasoline yields. For we undoubtedly will get some of the additional middle distillates we will need, to meet these new demands, by using them as such instead of cracking them for gasoline.

Most of the increased supply of middle distillates, however, will probably come from increased crude runs and, what is most significant, from more extensive processing of residual fuel oil. A trend toward increased production of light products from residual already is apparent. Currently residual fuel oil yields are almost 10 per cent less than they were a year ago, or about two per cent in terms of crude. It seems logical that this trend will continue as technology permits, because it gives products with a higher market value. And in some areas it will not only pay a refiner to make lighter products from his residual—in addition, it rapidly is becoming essential for balanced operation because of a loss of some markets for heavy fuel oil.

Therefore, I look for substantial efforts to improve the methods of reducing residual yields, with one of the major problems the finding of economical ways to accomplish this in small refineries. When the economic incentive exists, as it does, we can be sure that continued rapid progress will be made.

This discussion of the possibility of producing more light fuels from residual also bears on what I consider an extremely important subject—the current suggestions that there be an immediate start on a large-scale program for the construction of synthetic plants using coal and shale. These are, of course, major potential sources of light liquid fuels. Quite probably, one or both of them will come into substantial use some time in the future.

In my view, however, there is a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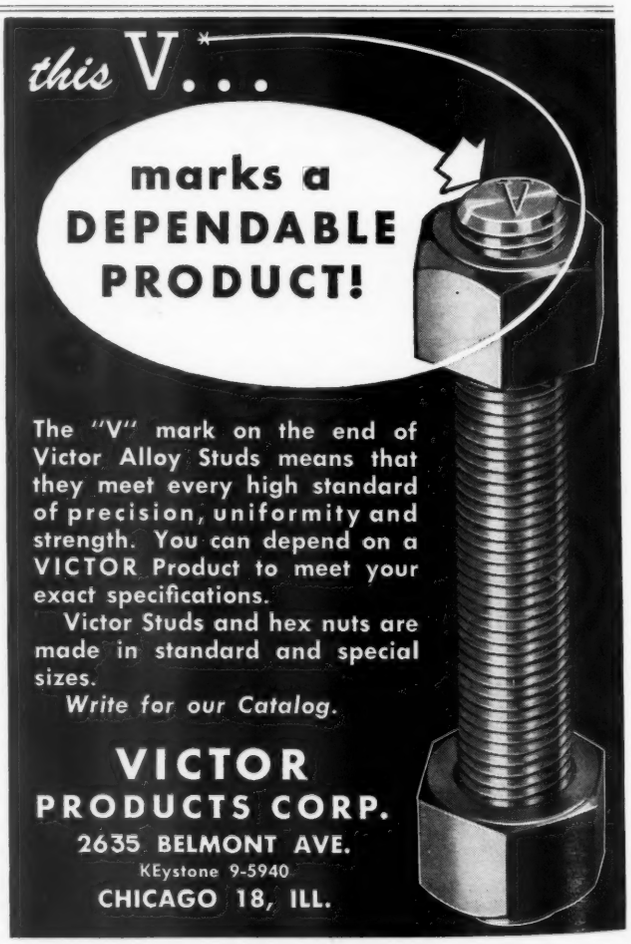
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serious question whether the national welfare would be served by starting such a program now, either for immediate or near-future domestic petroleum requirements, or as stand-by capacity for a potential emergency.

In the first place, and fundamentally, there is every evidence that for many, many years Western Hemisphere crude oil production will continue to be adequate for any Western Hemisphere requirements. We are not running out of oil.

But in addition, if it were necessary, there is another source of light liquid fuels—residual fuel oil—which can provide increased quantities of light products more economically and more rapidly than they can be obtained from synthetic plants. For even if the demand for petroleum products should reach the level of crude oil availability, the refineries would be producing large quantities of residual fuel oil which could serve as a better raw material than coal or shale for an increase in the manufacture of light fuels.

Such a solution to the problem would involve in many areas the direct substitution of gas or coal for some of the present uses of residual fuel oil, and the direct production of lighter fuels from that residual. Synthetic production of liquid fuels, on the other hand, means the indirect, expensive, and less efficient manufacture of oil from coal or shale. Synthetic plants require larger investments, more manpower, and greater operating costs than the processing of residual.

All of these facts seem to me to point to but one conclusion—there is a serious question whether there is any economic, conservation, or national security need for embarking now on the large-scale construction of synthetic plants.

I don't mean to imply that there will not be a time when synthetic production may well be justified on all of these considerations. For that eventuality, oil company laboratories and pilot plants which have been working on the problems for years, already have solved most of them. And the study and development of known processes will continue to make them increasingly more efficient. Whenever the time comes, the oil industry will be ready. We could start right now, if it were necessary, but my guess is that it will be at least a generation away. What I do want to emphasize is that—first things come first. Before we turn to synthetic production, let's use the better alternative first, if we have to.

As I pointed out earlier, the evolution of the domestic oil industry to meet the demands of its customers has resulted already in a gradual reduction of residual fuel oil yields and in the installation of more and more refining equipment for this purpose. This does not mean that the industry will go out of the residual business.

In the first place, a point is reached where the increasing cost of further reduction in residual yields leaves no economic incentive compared with sales of residual as such in direct competition with other fuels.

In the second place, the output of residual from increasing crude runs would tend to offset declining yields of this product.

Furthermore, consumers in some coastal areas where residual use is large, will be supplied economically from tributary off-shore sources as they have been for many years.

In short, we can be sure that residual demands will be met by the industry.

Lubricating oils present another challenge to the refiner. Modern machinery continues to place increasingly severe demands upon lubricants. They must perform under wide ranges

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of temperature and under extreme pressures. Additives, as well as improved refining methods, can help to meet these service conditions. Refiners will have to be prepared, therefore, to develop and use an ever-changing variety of additives to give special properties to lubricating oils.

One of the most interesting petroleum developments in recent years has been the growth in demand for liquefied petroleum gas. Sales have expanded from an insignificant volume 25 years ago to more than two and one-half billion gallons in 1948. This figure is expected to grow and at a rather rapid rate.

Now that the market has developed, the industry must be prepared to supply this popular product in quantities sufficient to meet the demand. Already refinery facilities, designed principally to collect and segregate butane, have had to be expanded for large-quantity output of propane as well. This is a trend which will continue.

Chemicals from petroleum are another example of small beginnings growing into large projects, and promising even greater opportunities in the future. The petroleum chemical business started with a small production of alcohol from cracking gases. But the growing realization of the usefulness of petroleum as a raw material for chemicals soon enabled it to yield so-called coal tar chemicals, and the equivalent of grain alcohol. Up to the beginning of World War II, toluene had been almost 100 per cent a coal tar product. Then, almost overnight, it seemed, more was being produced from petroleum than from coal tar. And, as we are all proud to recall, our petroleum refineries were our rubber plantations during the war. They are still producing large quantities or raw materials for synthetic rubber.

The United States Tariff Commission reports that the sale of organic chemicals produced from petroleum and natural gas exceeded three billion pounds in 1947. Although this is not a large figure in comparison with the great volumes with which the oil industry is familiar, it demonstrates that chemicals from petroleum represent a development of increasing importance, and one which we certainly will not neglect. Products made from the chemical building-blocks of oil enter the lives of everyone in hundreds of ways, and they offer all of us significant opportunities for contributing to better living.

In this connection, there is a notable trend toward the isolation of essentially pure compounds from petroleum. An example is the production of cyclo-hexane for use in the manufacture of nylon. To get these pure compounds we must develop better separation methods, another important job for the future. In this chemical business we will naturally rely on research and development workers more than ever.

To sum up, it seems to me that refiners will be looking at three main problems for the future: improvement in quality of gasoline and lubricating oils; increase in the yields of the middle distillates, with the more intensive processing of residual fuel oil an important part of this; and production of an increasing number of new products. That is a big assignment and it is not simplified by the changing characteristics of available crude oils. And we must bear in mind, in any discussion of a new synthetic industry, that our large supplies of residual fuel oil should be considered first as a better potential source of light products.

Future refining operations will increase in both complexity and flexibility. They will be more complex because the variety of products from petroleum is expanding continuously, and because many products are the result of highly involved processes. They will have to be flexible because rapidly fluctuating demands for individual products require techniques readily adaptable to changing needs.

Solving some of these problems will require the assistance of new techniques. But certainly the outlook in that respect is an encouraging one when we consider the facilities for research and development that are now available, the programs already under way, and the skill of the scientists and engineers in our laboratories. With advantages such as these, experience suggests that no problem of the future will long impede the progress of the refining branch of the oil industry.

It is you gentlemen here tonight, and your associates who will be responsible for getting the job done—and I know you can do it.

One final word—America's oil companies have done, are doing, and will continue to do, an outstanding job of supplying people's needs for liquid energy. They have accomplished this in a manner which has served the best interests of our government, of our consumers, of our stockholders, and of our employees. Too many people don't know that, and readily accept inaccurate statements about our industry. It is a definite part of your job and mine to do everything we can to tell the facts about America's progressive oil industry. * * *

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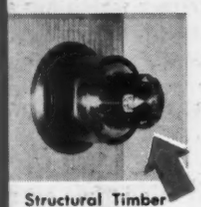

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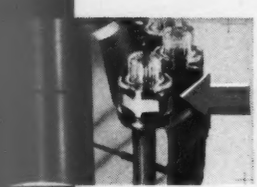

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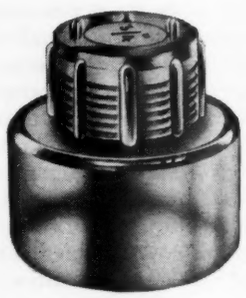

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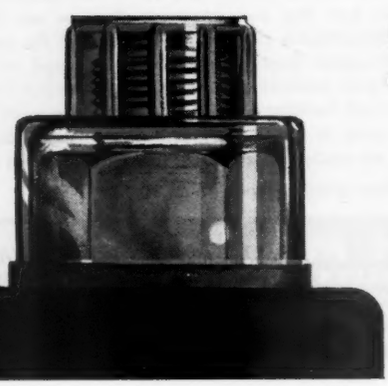

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A. E. CHESTER

Vice President and Manager of Production for Magnolia Petroleum Company

THIRTY years ago, in August, 1919, Andrew Emerson Chester, manager of Magnolia's Producing Division, was released from the Army Air Corps as a World War I pilot. The war had interrupted his schooling in his senior year at Vanderbilt University in Nashville, Tennessee, so Chester didn't waste any time in getting a job. While being trained in Texas, he had become interested in the oil industry as a likely business for a young man to follow, so he headed for the new boom town of Desdemona. Just ten days after he put away his lieutenant's uniform, Chester donned roustabout's clothes to begin work with Magnolia.

His rate of pay at that time was $4.50 a day with hours of work unlimited and seven days of work every week. Any old timer will tell you that the Desdemona boom in 1919 was rough and a man had to be rugged to get through it.

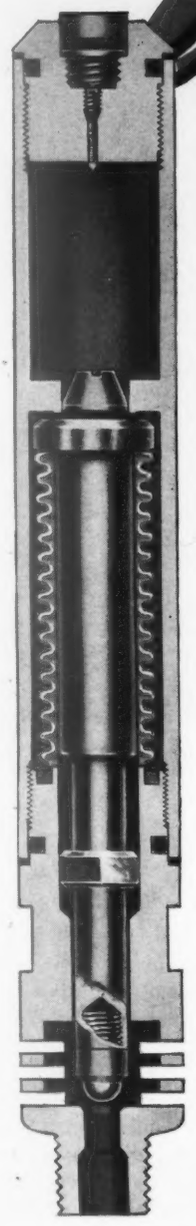
Chester was soon taken out of the roustabout gang and assigned to a cleanout rig as helper. After a short time as helper, he became a cleanout driller. A year later a cleanout man was needed in the Mexia field, then at the peak of its activity, so Chester was transferred to Mexia. After the Mexia boom, he was moved back to Desdemona, where he was made a gang-pusher. Two years later he was moved to Iatan, where he was soon promoted to production foreman. In 1935 he was made district superintendent of the Panhandle District headquarters at Pampa, Texas.

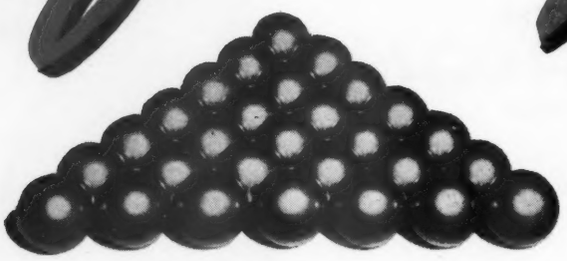
In May, 1936, Chester was transferred to Socony-Vacuum Oil Company's White Star Division for some drilling and production development work in Michigan. Two years later he was moved to Illinois following the discovery of new oil fields there, and, in December, 1938, was transferred back to Magnolia as district superintendent at Salem, Illinois. The next year he was made division superintendent of the Illinois and Kentucky Division.

Chester was brought into the general offices in Dallas on January 1, 1944, and advanced to assistant manager of production. On January 1, 1948, he was made vice president and manager of the Producing Division and elected a director of the Company. In this capacity, Chester is in charge of all Magnolia's drilling and producing operations and exercises executive supervision over the Petroleum Enginering, Civil Engineering, and Shop Departments.

He is a Mason, an elder in the Highland Park Presbyterian Church in Dallas, and a member of the Petroleum Engineers Club of Dallas, the Dallas Petroleum Club, and the Dallas Country Club.

Uniformity





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AN IMPRESSIVE record of success has been marked up in our exploratory drilling for new petroleum reserves during the last ten years. This record, summarized in this issue in an exclusive article by Dr. Frederic H. Lahee, shows clearly that the exploration branch of the petroleum industry is meeting the challenge of increased demand imposed on our industry during and after World War II. Although more than three times as many exploratory wells were drilled in 1948 as in 1938, nearly four times as many of them were completed successfully as producers. This overall improvement in wildcatting success during the past ten years is shown graphically by the curve on the number of dry holes drilled for each successful producing well. This curve shows that 8.8 dry holes were drilled for each successful hole in 1939 and that only 4.5 dry holes were drilled for each successful hole in 1948. No better proof of the marked improvement of our overall exploration efforts could be given. We could have been proud of a much poorer record, for we might have expected an increase in the number of dry holes drilled for each successful producing well instead of a decrease.

It appears from another curve in the article that fewer of the new discoveries are important petroleum reserves, but the conclusion may not be valid. Additional drilling around some of the small discovery wells is certain to bring a few of them into the limelight as important reserves in the years to come. Even some of the "dry holes" are bound to lead to important discoveries.

It is true that every new discovery reduces by one the number of fields yet to be found. On the other hand, new discoveries and even dry holes often lead to other new discoveries, and, in view of the impressive record during the past ten years, it would be unrealistic to conclude that we are anywhere near the end of our discovery days. It would be reasonable to conclude that we have not yet begun to find all of the recoverable petroleum deposits within our boundaries.

Why have we been more successful in finding oil than some other people in the world? Because we had more oil and gas deposits? Not at all! Many other countries have more oil and gas deposits than we do. The reason is simply this: We operate in a system of free enterprise that encourages all of the thousands of wildcatters to do the very best they can to find the most petroleum they can, for their rewards are in proportion to their success. We can be thankful that these independent exploratory efforts are opening so many new fields. No central authority could begin to approach the impressive record of success attained by our independent operators.

K Marshall Fagin

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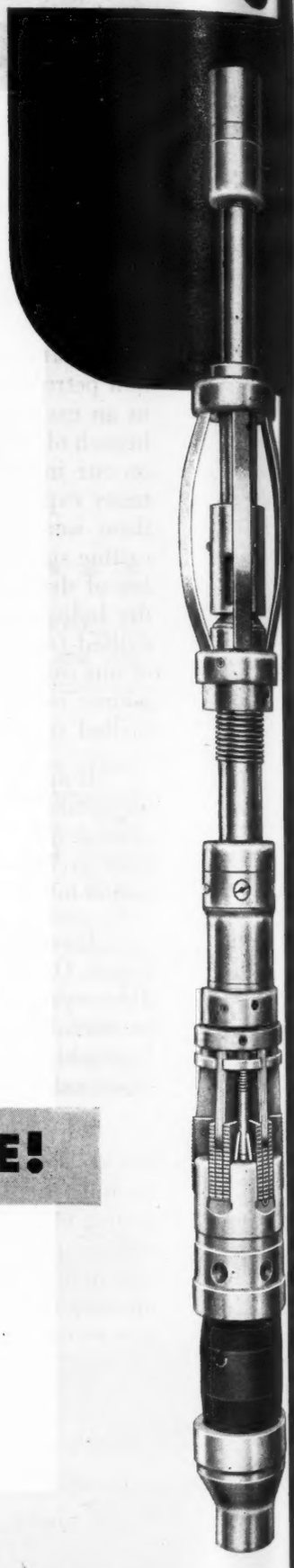

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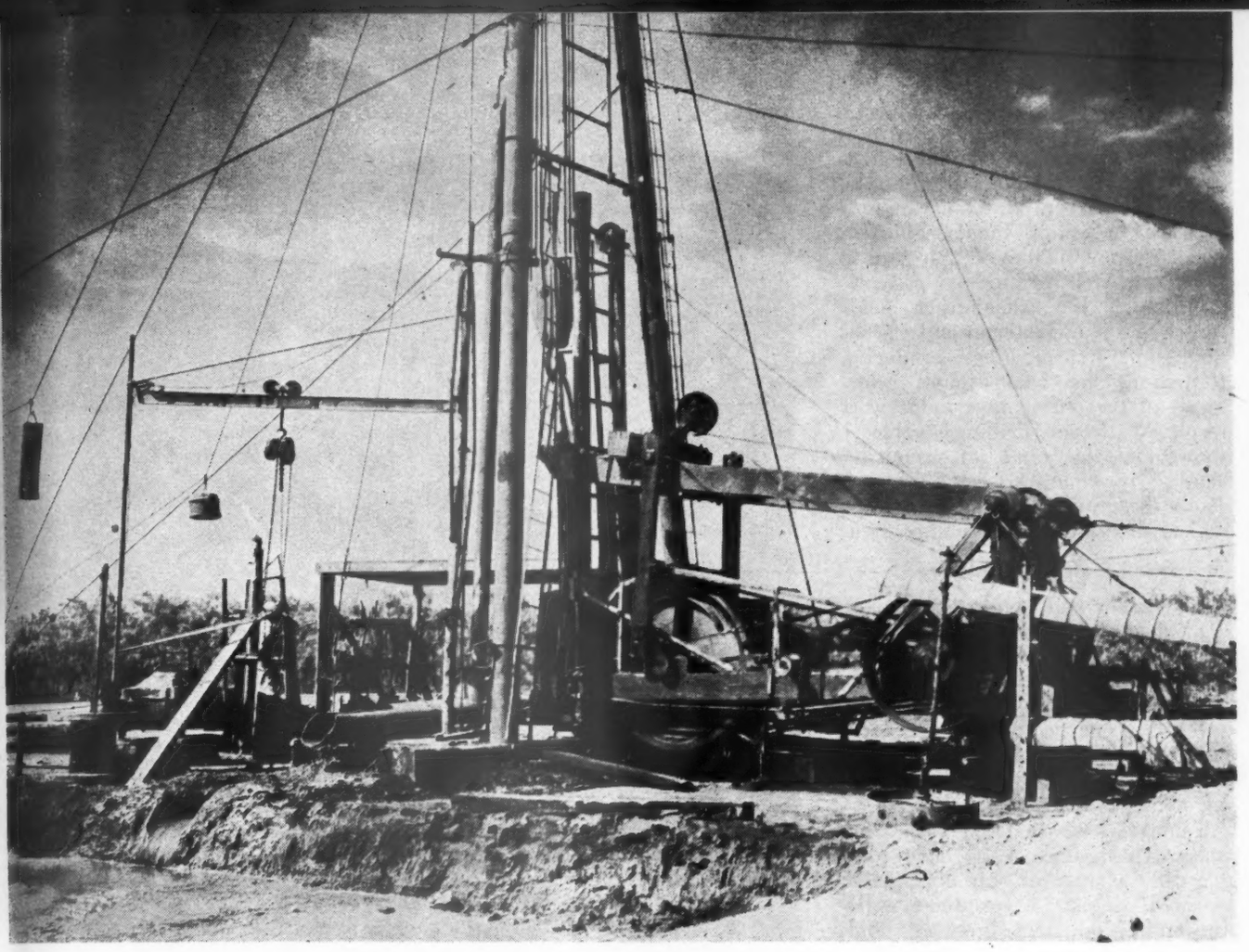


Cable tool spudder drilling a 1700-ft Bluff Creek sand well in the Ramsey area, Jones County, Texas. Notice the main drive belt guards welded from oil drums (right).

P 419.

Economics of Shallow Drilling

K. MARSHALL FAGIN*

ALTHOUGH the present daily production of all the fields in West Central Texas is only about half of a single 100,000-bbl "bonanza" field such as Breckenridge in its heyday, the present production represents a much larger backlog of crude oil reserves. The new flush fields in this area are not being produced as wide open as possible. Instead, they are being operated under conservation rules and efficient practices that were unheard of in the days when Ranger and Desdemona gas wells were allowed to "blow themselves into oil."

Gas wells and high gas-oil ratio wells are no longer permitted to waste their production and thus prematurely deplete the reservoir energy in oil pools. On the contrary, excess casinghead gas and even purchased gas is being injected voluntarily into more than a score of pools to revive oil production from several thousand acres of land. Several of these gas drive projects are reported to have doubled the primary oil recovery from some of the Fry and Cook sand pools affected. As much as 500 bbl per acre-ft has been recovered from some of these shallow sands instead of the usual 200 to 250 bbl.

Waterflooding has been tried in 10 or more shallow sand pools in this area. The practice has proved effective in recovering two or three times as much oil as was produced by primary methods. It is hampered, however, by the general scarcity of an ample supply of cheap water for flooding purposes. As such supplies can be developed, and so long as the price of crude oil remains about where it is, more flooding projects may be activated.

The multitude of small shallow oil fields that dot the plains of West Central Texas are a tribute to the hundreds of small operators and independents that have been prospecting the area since the first small field was

*Editor, Exploration, Drilling, Production.

EXCLUSIVE

discovered in Coleman County in 1910. Scores of these operators have grown stronger as the search for oil has grown deeper, and many are now engaged in testing the Ellenburger, which is from 3000 to 6000 ft deep in this Bend Arch region.

Although the Ellenburger fields found so far do not appear to be of great importance, other producing formations are being found below many of the old shallow fields as a result of deeper drilling. Table 1 shows the wide range of producing depths by counties, and Table 2 shows the producing depths for some typical fields in this 15-county area.

Small Fields—Small Wells

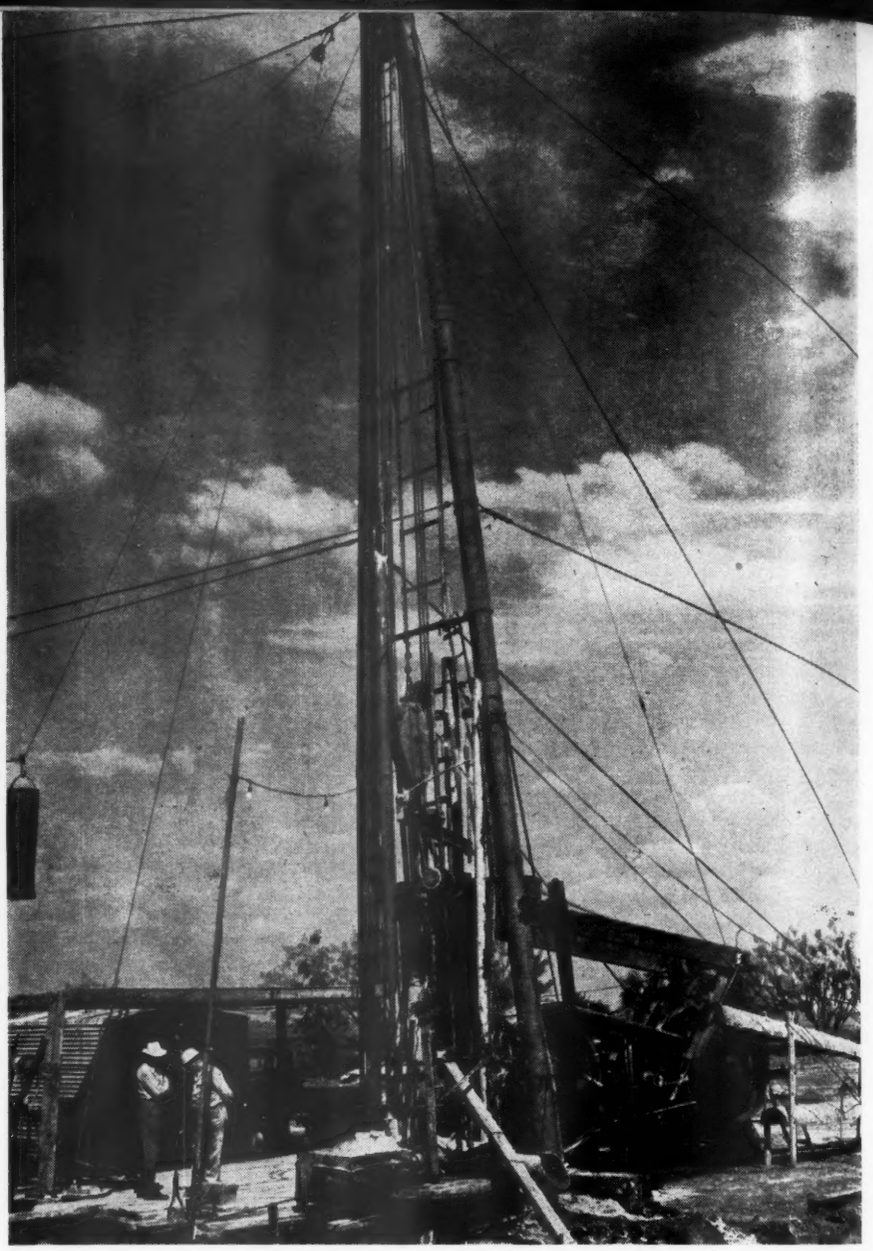
The erratic and lenticular nature of the effective producing sands and limestones in the small fields scattered over this area, and the usual low initial productivity and ultimate recovery has retarded development, and has made West Central Texas relatively unattractive to the larger drilling and producing companies.

Table 1 shows that the 18,246 oil wells drilled since 1910 have produced an average of only 25,300 bbl per well. About 7300 of these wells are still producing, however, and might be expected to produce 240,000,000 bbl more. This would raise the average cumulative per well to about 37,000 bbl.

New Multi-pay Fields

The present wells, particularly those drilled during the last 10 years, are deeper and somewhat more prolific than the earlier wells. Many will be plugged back or drilled deeper to tap other productive zones when the present producing zones becomes noncommercial.

Table 2 shows that as many as 10 producing zones have been developed to some extent in Wimberly and Reddin fields, and that many other fields have already developed some production from more than one zone. Some of these multi-pay fields have dually completed wells or twinned wells. A few fields have not yet been developed in known producing zones.



Cable tool spudding units like the one above are used widely in drilling the 500 to 3500-ft shallow wells in the West Central Texas area. Water sands are not troublesome, and 70 to 140-ft hole may be drilled in one day.

TABLE 1. Production record of oil wells in West Central Texas.

County	Discovery year	No. oil wells: Total* drilled	No. oil wells: 1948	Oil production, thousands of barrels: Cumulative	Oil production, thousands of barrels: 1948	Average production per well, thousands of barrels: Cumulative	Average production per well, thousands of barrels: 1948	Bbl per day	Depth range, ft: from	Depth range, ft: to
Brown	1917	2,500	579	33,435	385	13.4	0.7	1.8	100	3,000
Callahan	1920	1,300	943	19,595	275	15.0	0.3	0.8	150	4,300
Coleman	1910	1,000	509	18,595	1,295	18.6	2.5	7.0	400	3,975
Comanche	1919	250	205	2,574	389	10.3	1.9	5.2	300	4,000
Eastland†	1917	3,300	396	104,237	897	31.7	2.3	6.2	1,200	4,200
Erath†	1920	60	14	552	20	9.2	1.4	3.9	1,625	3,400
Fisher	1928	230	133	16,568	963	72.1	7.2	19.8	2,600	5,550
Haskell	1928	50	47	927	283	18.5	6.0	16.6	1,500	4,250
Jones	1926	1,350	1,039	47,066	5,193	35.0	5.0	13.6	1,600	4,539
Palo Pinto	1915	550	42	6,057	95	11.0	2.3	6.2	400	4,320
Shackelford	1911	2,700	1,948	54,301	1,971	20.2	1.0	2.8	200	4,600
Stephens	1915	3,900	716	143,828	2,821	36.8	4.0	10.8	1,800	4,500
Stonewall	1938	6	4	319	19	53.1	4.8	13.0	4,150	6,000
Taylor	1916	300	254	6,066	1,685	20.2	6.6	18.1	1,600	4,200
Throckmorton	1924	750	493	8,564	2,336	11.4	4.7	13.0	300	5,000
Total (15 counties)	1910	18,246	7,322	462,684	18,627‡	25.3	2.5	7.0	100	6,000

*Estimated total number of oil producing wells drilled since beginning.
‡Total daily average production during 1948=51,000 bbl per day.
†Erath county portion of Desdemona is included in Eastland county.

Jones County Ahead in 1948

Table 3 shows the importance of the leading oil producing counties in this area according to the total number of oil wells drilled, cumulative production, and production during 1948. Although Breckenridge puts Stephens County in first place in number of wells and cumulative production, it was surpassed by Jones County in production during 1948.

Ranger and Desdemona placed Eastland County second in importance for number of wells and cumulative production, but it was only eighth in 1948 production. The discovery of new deeper fields, such as Kleiner (Mississippian), may bring it up some this year.

TABLE 2 Well and production data for some typical fields in West Central Texas.

County	Field	Discovered mo.	Discovered year	Daily allowable,* June 1, 1949 No. wells	Daily allowable,* June 1, 1949 Barrels	Daily allowable,* June 1, 1949 Avg. per well	Cumulative 1-1-48, thousands of barrels Total	Cumulative 1-1-48, thousands of barrels Per well	Producing depth, ft	Remarks
Brown	Blake (Caddo)	4	1948	21	530	25.2	99	4.7	2,100	
Callahan	Baum	5	1947	7	346	49.5	57	8.1	3,840	
	Scranton	3	1939	7	18	2.6	156	22.2	1,675	
Coleman	Anzac-Morris	5	1939	14	215	15.4	541	38.7	2,200	
	Coker	4	1942	23	321	14.0	995	43.2	3,000	
	Jack A. Rhodes	12	1948	2	120	60.0	.....	.....	2,680	
	Williams	3	1944	21	621	29.6	950	45.2	3,750	
Comanche	Kirk	1	1948	109	1,455	13.3	350	3.2	2,800	
Eastland	Kleiner (Miss.)	7	1948	15	936	62.3	76	5.1	3,900	
Fisher	Eskota	8	1946	24	1,183	49.4	528	22.0	4,400	Also, 2,600 and 2,870 ft
	Pardue	4	1949	3	239	80.0	.....	.....	3,775	Also, 5,948 ft
	Radford	4	1949	1	100	100.0	.....	.....	4,732	
	Roby (Cook)	5	1949	1	76	76.0	.....	.....	3,510	
	Roby (Flippen)	11	1948	2	160	80.0	.....	.....	3,536	
	Roby (Swastika)	2	1949	2	200	100.0	.....	.....	4,040	
	Rotan		1937	12	89	7.4	1,977	49.0‡	3,600	
	Round Top	2	1947	53	3,836	72.2	480	9.1	4,700	Also, 3,900 ft
	Royston	1	1928	52	491	9.5	13,200	112.0‡	3,120	
Haskell	Humphrey-Chapman	11	1946	17	307	18.1	244	14.4	2,550	Also, 4,060 and 4,250 feet
	Lawson	12	1941	11	358	32.6	389	35.4	2,700	
	Weinert	5	1949	1	100	100.0	.....	.....	4,735	
Jones	Akard	12	1938	27	166	6.2	742	22.5‡	2,150	
	Anderson	2	1949	4	240	60.0	.....	.....	2,650	
	Anson	9	1948	5	350	70.0	.....	.....	3,600	
	Anson (Flippen)	10	1948	1	8	8.0	.....	.....	2,270	
	Avoca	7	1937	49	1,377	28.1	5,300	108.0	3,300	
	Bartlett	1	1948	58	2,900	50.0	366	6.3	3,200	
	B B	4	1947	8	260	32.5	40	5.0	3,000	
	Griffin	11	1938	49	1,318	26.9	5,150	76.0‡	3,250	
	Hardy	11	1943	24	1,511	63.0	657	27.4	3,650	
	Humphrey (Gray)	12	1948	6	320	53.3	.....	.....	2,100	Also, 1,629 and 1,990 ft
	Largent	8	1948	4	291	73.0	5	1.2	4,650	Also, 4,316 ft
	Lewis-Steffins		1936	139	394	2.8	3,227	15.4	1,900	
	Noodle (Central)	5	1943	18	433	24.1	850	47.1	2,800	Also, 3,000 and 3,715 ft
	Noodle (Reef)	4	1946	8	400	50.0	232	29.0	3,300	
	Noodle (South)	1	1941	14	344	24.6	746	46.6‡	3,050	Also, 2,400 and 2,700 ft
	Pitzer	11	1946	19	1,257	66.1	214	11.3	4,600	
	Ramsey	8	1948	5	200	40.0	5	1.0	1,680	
	Sayles		1933	98	677	6.9	3,734	35.0‡	1,950	
	Strand	9	1940	6	198	33.0	405	40.5‡	3,400	
	Wimberly	3	1941	207	4,179	20.3	7,168	34.6	2,400	10 pay zones between 2,100 and 2,600 ft
Shackelford	Hubbard Creek (Ellen)	3	1949	10	403	40.3	.....	.....	4,200	Also, 3,900 ft
	Ivy	1	1937	54	584	10.8	3,845	44.5‡	3,200	Also, 1,400 and 1,900 ft
	Kadane Beaumont	4	1949	2	120	60.0	.....	.....	2,070	
	Nail	6	1937	16	82	5.1	1,002	21.4‡	1,450	
Stephens	Crystal Falls (Miss.)	9	1948	5	455	91.0	13	2.6	4,300	Also, 3,416 ft
	Double D (Ellen)	7	1948	18	1,314	73.0	54	3.0	4,400	
	Ibex, East	4	1947	35	1,996	57.0	904	25.8	4,300	
Taylor	Bird	3	1948	5	231	46.2	26	5.2	2,700	Also, 2,100 and 2,400 ft
	Caldwell Ranch	3	1949	3	117	39.0	.....	.....	1,680	
	Ferrell	11	1947	4	165	41.2	53	13.2	2,480	
	Gibson	8	1948	24	1,385	57.9	31	1.3	2,800	Also, 2,200 and 2,600 ft (7 pay zones)
	Hogan	4	1949	2	120	60.0	.....	.....	2,760	
	Merkel	6	1941	15	134	8.9	613	30.7‡	2,500	
	Murphree	5	1946	16	366	23.0	327	20.4	2,700	4 pay zones
	Reddin	9	1942	149	3,473	23.3	3,600	24.2	2,400	10 pay zones between 1,800 and 2,600 ft
	Reidenbach	6	1948	10	370	37.0	41	4.1	2,600	3 pay zones
	Riney	4	1949	3	180	60.0	.....	.....	2,730	
Throckmorton	Ewalt	9	1944	4	113	28.3	145	29.0‡	4,800	Also, 4,100 ft
	McKetchan (Miss.)	8	1948	2	200	100.0	17	8.5	4,500	
	Mudge Graham (Caddo)	4	1947	1	64	64.0	22	22.0	3,980	
	Schittler	3	1948	3	135	45.0	20	6.7	3,700	
	Wright	1	1948	2	150	75.0	31	15.5	4,740	Also, 4,240 ft

‡Adjusted for wells that have been abandoned.

*Some of these fields are subject to the Texas Railroad Commission's statewide shutdown order, and, consequently, do not produce the allowable every day.

Shackelford County Important

Shackelford County is the third leading County in number of wells and cumulative production, and ranked fourth in 1948 production. Discovery of the Hubbard Creek Ellenburger field in March of this year (Table 2) and other favorable developments may help it maintain a leading position. Brown County was fourth in number of wells and fifth in cumulative production, but was greatly surpassed by Jones County in 1948 production.

It is interesting to note that 75 per cent of the oil wells were drilled in 5 of the 15 counties, and that they have produced 83 per cent of the oil from this area. Only 64 per cent of the oil wells were in these 5 counties in 1948, and they produced about 60 per cent of the oil. Shackelford County had the most wells in 1948.

TABLE 3. Leading oil producing counties in West Central Texas.

County	Oil wells drilled since beginning Total	Place	Cumulative production Thousands of bbl	Place	Cumulative per well Thousands of bbl	Place	1948 production Thousands of bbl	Place	1948 daily per well Barrels	Place
Stephens	3,900	1	143,828	1	36.8	3†	2,821	2	10.8	7§
Eastland	3,300	2	104,237	2	31.7	5	897	8@	6.2	9@
Shackelford	2,700	3	54,301	3	20.2	6	1,971	4*	2.8	13#
Brown	2,500	4	33,435	5	13.4	11‡	385	10△	1.8	14
Jones	1,350	5	47,066	4	35.0	4	5,193	1	13.6	4+
Total	13,750	....	382,867	....	.....	....	11,267	....	.....	....
Per cent of district	75	....	83	....	.....	....	60	....	.....	....

†Fisher county ranks first with 72,100 bbl per well, and Stonewall county ranks second with 53,100 bbl per well.

‡Taylor county ranks seventh with 20,200 bbl per well. Coleman county ranks eighth with 18,600 bbl per well, Haskell county ranks ninth with 18,500 bbl per well, and Callahan county ranks tenth with 15,000 bbl per well.

*Throckmorton county ranks third with 2,336,000 bbl.

@Taylor county ranks fifth with 1,685,000 bbl, Coleman county ranks sixth with 1,295,000 bbl, and Fisher county ranks seventh with 963,000 bbl.

△Comanche county ranks ninth with 389,000 bbl.

+Fisher county ranks first with 19.8 bbl daily per well, Taylor county ranks second with 18.1 bbl daily per well, and Haskell county ranks third with 16.6 bbl daily per well.

§Stonewall county ranks fifth with 13.0 bbl daily per well, and Throckmorton county ranks sixth with 13.0 bbl daily per well.

@Coleman county ranks eighth with 7.0 bbl daily per well.

#Palo Pinto county ranks tenth with 6.2 bbl daily per well, Comanche county ranks eleventh with 5.2 bbl daily per well, and Erath county ranks twelfth with 3.9 bbl daily per well.

Fisher County Wells

The per well data shown in Tables 1, 2, and 3, should be of particular interest to operators who are interested in selecting a drilling area on averages as well as on best geological evidence available. Fisher County had the highest average production per well during 1948, 19.8 bbl per day. Taylor, Haskell, Jones, Stonewall, Throckmorton, and Stephens counties were next in the order named.

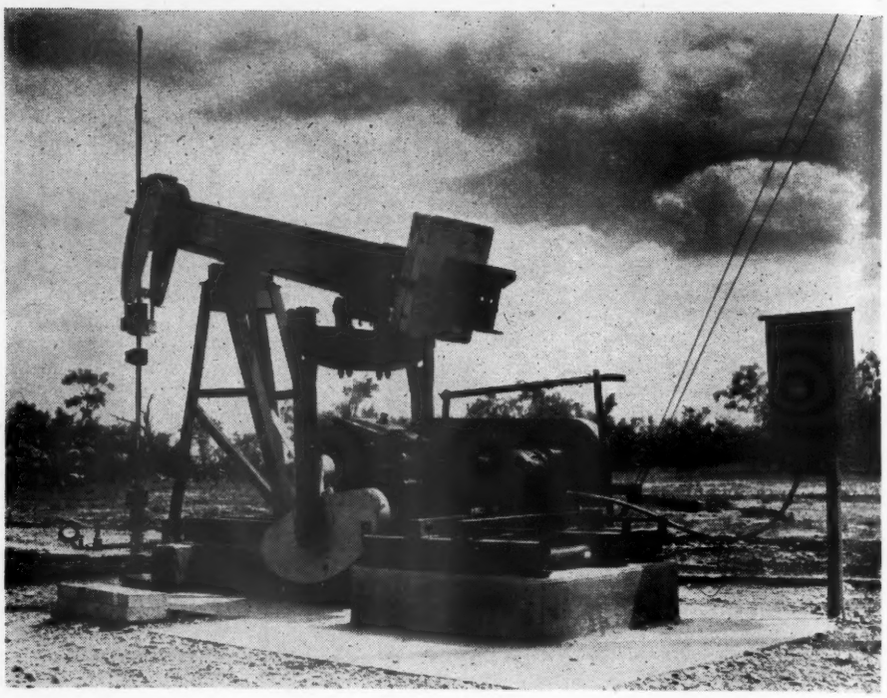
Fisher County had the largest average cumulative production per well, 72,100 bbl. Stonewall, Stephens, Jones, Eastland, Shackelford, and Taylor counties were next in the order named.

High Allowable Attractive

The real lure for operators in West Central Texas, however, is the relatively high per well allowable that is granted for a shallow well. This probably encourages wildcat and development drilling more than any other single factor, because the investment in wells and lease equipment is paid back faster (if the wells are successfully completed) than in some richer fields in other parts of the State. The comparatively low average ultimate recovery per well in this area does not matter so much when the operator is assured that he can get his investment back in less time.

Table 2 shows the average scheduled allowable for June 1, 1949, for some of the typical fields in this area. Many flush wells in new fields are included in the "regular" allowable schedules for the various counties. Such fields are not shown, as they are not grouped by fields in these schedules. Flush wells in the "regular" county schedules have the advantage of obtaining the highest statewide allowable for their depths and exemption from statewide shutdown days. days.

A 2,000-ft discovery well, for example, would be granted a 20-bbl per day allowable and could produce every day. Should the same well be classed as a "new field" well, the operator would get a higher "discovery" allowable, but would have to observe the twelve or 13 statewide shutdown days each month unless he could obtain a special exemption by a showing of cause at a hearing.



Pumping unit on Davisson's No. 4 Hugh Roberts is started and stopped daily by time clock switch in control box (right), to produce the daily allowable of 20 bbl.

TABLE 4. Estimated cost of drilling a 1700-ft Bluff Creek sand well.

Drilling contract*	$3.00 per ft	$5,100
Casing, 7 inch	1.60 per ft	2,720
Tubing, 2 inch	.50 per ft	850
Surface casing, 10¾ inch	2.00 per ft	200
Sucker rods, ⅝ inch	.25 per ft	425
Pumping jack, well head connections, electric motor, time switch, and flow line		1,500
		$10,795

*Includes cementing casing, shooting with 2 qt per ft, cleaning out, and completeing well.

TABLE 5. Estimated monthly income from a new Bluff Creek sand well.

Allowable—(20 bbl per day × 30 days)	600 bbl
Total value—(600 × $2.65 —.11 tax)	$1,524
Operator's share—($1,524 × .875)	1,333
Less direct lifting cost (incl. ad valorem taxes)	150
Estimated direct net income to operator	1,183

TABLE 6. Estimated ultimate income from a Bluff Creek sand well.

Estimated effective sand thickness	20 ft
Estimated producing area	10 acres
Estimated ultimate production	30,000 bbl
Estimated total value (30,000 × $2.54)	$76,200
Operator's share ($76,200 × .875)	66,675
Total direct lifting cost (100 Mod. × $150)	15,000
Estimated direct net income to operator	51,675

Shallow Well Costs

Table 4 shows the approximate cost of drilling and completing a 1700-ft sand well in the Neugent area of Jones County. Such a completed well is shown in an accompanying photograph. The total cost, including flow tanks, might be as much as $12,000. Some operators report, however, that they are now able to complete such wells and equip them for production for about $10,000.

Table 5 shows an estimate of an operator's monthly income from a new Bluff Creek sand well that is capable of making the "regular" allowable of 20 bbl per day. The direct lifting cost varies largely with the number of wells operated by a pumper.

Oil from this sand and most other formations in West Central Texas is high gravity sweet oil. Gas-oil ratios are generally very low in the shallower sands. Water production with the oil is negligible and seldom troublesome. For these reasons, separators and gunbarrels are not always required. Consequently, the lifting costs are largely dependent on the cost of labor.

Although it might be concluded from studying Tables 4 and 5 that the investment in a 1700-ft Bluff Creek sand well might be paid out in 10 or 11 months, the payout depends on the particular well's ability to continue producing 20 bbl per day for that length of time. Some can do it easily. Others settle rapidly, due to lack of reservoir energy or low permeability.

Table 6 assumes that a Bluff Creek sand well will yield about 30,000 bbl of oil, or 150 bbl per acre-ft of effective sand. Some yield more and others less. The important fact is that the production declines during the well's life (unless the reservoir pressure is maintained by gas or water injection), and that the total lifting cost may remain about constant.

In this estimate, it is assumed that the lifting cost over a 100-month period would amount to $15,000, and that the ultimate income to the operator would be about $50,000. The drilling of such a well might (at the present price for oil) yield a net return of 5 times the investment before overhead, interest, and income taxes.

* * *

Planning, Running, and Cementing Casing Strings

NICHOLAS A. TINKER, JR.

In the past few years the use of casing scratchers and centralizers to obtain effective primary cement jobs has become widespread. This practice might be more extensive if careful thought had been given to the cause of cementing failures where scratchers and centralizers were used. In many cases these devices have been condemned without studying the facts after one unsuccessful attempt to use them.

Planning is the most important consideration in any operation that involves the expensive materials and costly risks that running casing does. This is especially true when new devices are being tried and the supervisory personnel do not properly understand how to use the equipment.

Where scratchers and centralizers are to be used for the first time, it is advisable to outline the plans in writing with the help of someone who has had experience with scratchers and centralizers and who reasonably understands their application. Then the supervisory personnel should be supplied with a copy of these plans well in advance of the job, so that they may become familiar with the procedure to be used and thoroughly understand *why* it is to be used.

Planning the Job

Let us consider some of the problems that require careful planning prior to running casing that is to be equipped with scratchers and centralizers.

The approximate casing point, the approximate top of the desired cement column, and the spacing of the scratchers and centralizers are the first things that should be determined in formulating the detailed plans.

Scratcher spacing depends on the proposed length of the casing reciprocations during cementation and the operator's judgment. Their spacing depends on reciprocation length, because movement of the casing activates the scratchers and, if they are 35 ft apart, any reciprocation short of 35 ft would not scratch the entire sand face. As the scratcher bristles may distort and even break as the casing is run, it is a good idea to use more than the minimum number required. Here is where the operator's judgment enters, and his decision depends upon his knowledge of the well bore condition[1] and where an effective cement bond is needed.

Centralizer spacing depends on the size of the casing, compressive strength of the centralizer, and the deviation of the hole from vertical at the depth where the casing is to be centralized. Appendix I has a table of centralizer spacings with an example of calculations for conditions not covered in the table.

The probable casing point is generally fixed in the drilling authorization and the drilling contract, but the desired cement top, unless fixed by state or field rule, depends entirely on the operator's judgment. The cement top is usually placed a few hundred feet above the uppermost stratum containing oil, gas, or corrosive water.

Racking the Pipe

Once the desired top of cement is determined, the casing should be checked to ascertain that it is racked properly for running, that there is a sufficient length of casing on the top layer to span the proposed cement column, and that there is some spare room for rolling the casing along the top layer while "dressing" the joints with scratchers and centralizers. In wells where extremely long columns of cement are desired the construction of additional racks may be necessary, so the decision on where the top of the cement is to be should be made as early as possible.

Next are the plans for conditioning the drilling fluid and the well bore as the casing is being run, or, as it is commonly referred to—picking the points of progressive circulation. The purpose of progressive circulation is four-fold: (1) To remove by stages the drilling fluid that has been standing in the hole increasing in weight and viscosity for several hours. (2) To bring cuttings and "chunks" of filter cake to the surface that have been dislodged by the passage of the scratchers and centralizers. (3) To partially clean or "condition" that portion of the well bore that is above the casing shoe at the point of circulation, thereby reducing the danger of sticking the casing string. (4) To permit the starting of mud circulation from each depth at a minimum pump pressure by removing the heavy, viscous mud from the well bore in stages rather than all at once. This is extremely important in wells where there has been loss of returns while drilling.

Planning Connections

The progressive circulation plans should include how the mud and cement lines are to be connected to the casing cementing head during the cement mixing and displacing operation and at each progressive circulation point. This complete set of connections should be ready for use prior to starting casing in the hole, so that there will be no delay at the first circulating point.

If cementing and circulating is to be done through flexible pipe connec-

The Author

Nicholas A. Tinker, Jr., is associated with DeGolyer and MacNaughton in Dallas, Texas, as a reservoir engineer. He received his B.S. degree from the University of Oklahoma in 1940, and was employed by the Gulf Oil Corporation in West Texas after graduation. He returned to work for the Gulf in West and North Texas areas after serving four years in the Field Artillery during World War II.

His interest in casing scratchers and centralizers was aroused while doing field petroleum engineering work for the Gulf when that company began to use them widely in 1946. He has witnessed and supervised numerous casing cement jobs where scratchers and centralizers were used.

EXCLUSIVE

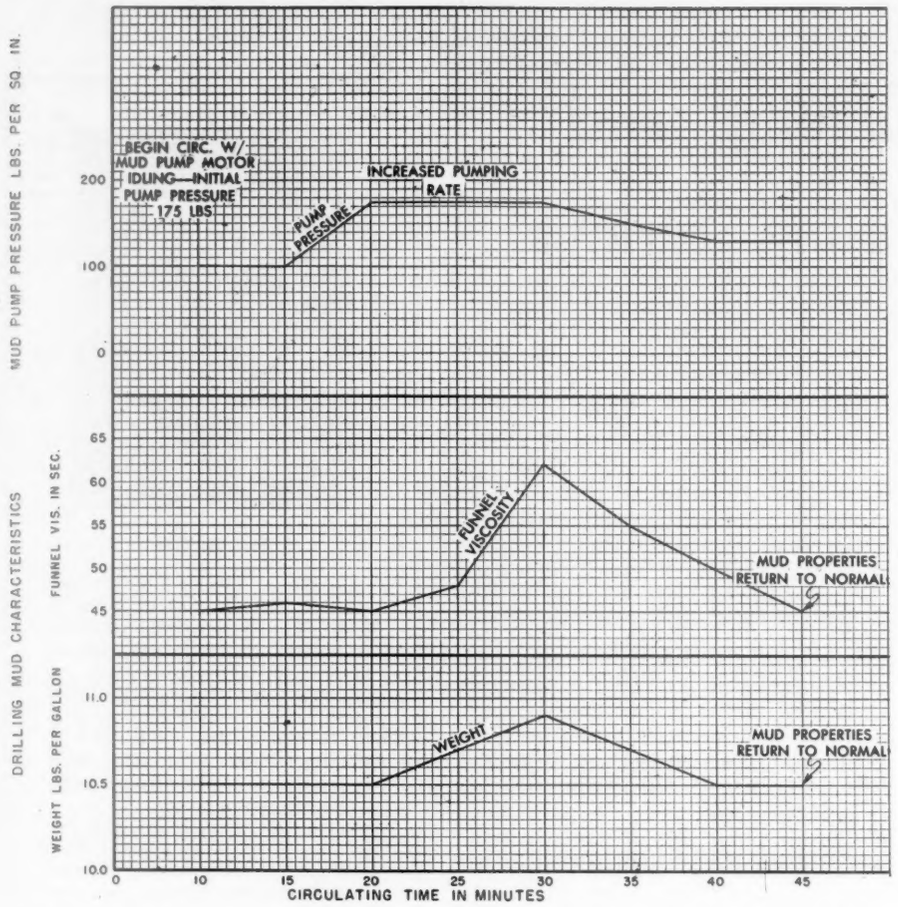

DRILLING MUD CHARACTERISTICS
MUD PUMP PRESSURE LBS. PER SQ. IN.
FUNNEL VIS. IN SEC.
WEIGHT LBS. PER GALLON
BEGIN CIRC. W/ MUD PUMP MOTOR IDLING—INITIAL PUMP PRESSURE 175 LBS.
INCREASED PUMPING RATE
PUMP PRESSURE
FUNNEL VISCOSITY
MUD PROPERTIES RETURN TO NORMAL
WEIGHT
MUD PROPERTIES RETURN TO NORMAL
CIRCULATING TIME IN MINUTES

FIG. 1. Time vs mud characteristics and mud pump pressures. Depth 2800 ft. Normal mud characteristics 10.5 lb per gal 45 sec F.V.

TABLE 1. Drilling mud tests during circulation period.

Remarks	Time	Mud characteristics		Mud pump pressure, psi
		Weight lb/gal	Viscosity, sec	
Total depth, 2779 feet.				
Began second circulation.	10:00			175
Pump pressure dropped after annular mud column in motion.	10:10	10.5	45	100
Increased pumping rate.	10:15	10.5	46	100
	10:20	10.5	45	175
Casing dropped several inches.....	10:25	10.7	48	175
each few minutes throughout	10:30	10.8	62	175
circulating period.	10:35	10.7	55	150
	10:40	10.5	50	140
Stopped circulation and began running casing.	10:45	10.5	45	140

tions rather than the rotary hose, a 20-ft stand-pipe can be erected above a 2-way circulating tee with the mud line connected to one side of the tee and the cement line (or lines) connected to the other side. The flexible pipe connections can be fastened to the top of the stand-pipe and to the cementing head then, and, as the casing is reciprocated, the flexible pipe connections will not touch the derrick floor. Although it is much simpler to circulate and cement through the rotary hose, some contractors object to this practice.

Progressive Circulation Points

Actual depths for circulating cannot always be determined beforehand. Approximate depths can be agreed upon, however, and the procedure planned on that basis. Under normal circumstances, a plan to circulate every 1000 to 1500 ft is all right, but, where hole and/or drilling fluid are in bad condition, more frequent circulating may be advisable.

On any job, however, when the casing shows signs (on the weight indicator) of dragging or sticking, it is wise to circulate immediately, regardless of previous plans and agreement. The mud pump pressure gauge should be observed as circulation is established and, if the pressure is high for that depth, less casing should be run to the next circulating point.

The first circulating point should be, where possible, just above the casing shoe of the surface or intermediate string. This has the advantages of familiarizing the personnel with the procedure and of allowing them to test the equipment at a time when a long delay would not be hazardous.

Casing Movement Desirable

It is not the purpose of progressive circulation to clean the well bore. It may be dangerous, however, to leave the casing string stationary for any appreciable length of time even while circulating. For this reason, the casing string should be moved slowly throughout these circulating periods. Failure to move the casing periodically allows cuttings to collect beneath the scratcher bristles and in enlarged sections of the hole (because of decreased annular mud velocities in these large areas),[1] and in time the casing may become immovable or circulation lost or both.

One procedure that decreases connection time and allows movement of the casing during circulation with a minimum of trouble is as follows: When the casing is near the desired circulating depth, install the circulating swage (or cementing head) on the next casing joint that is to be stabbed. After this joint is made up on the casing string, connect the hose to the circulating head in the derrick. Then, simply lower the casing string several inches each minute or two during the circulating time.

The distance the casing is moved is not as important as the time between moves. Very little movement of the casing will clear the scratchers of cuttings and clear out bridges that begin to form provided neither has been allowed to progress too far.

The circulating swage and hose may be connected to the casing at floor level. Then, the casing can be raised and lowered after circulation is begun. This method is often used, but should the casing become stuck while the connections are being made, there would be less distance to drop the casing in attempting to free it, and the addition of another joint would require much valuable time. In passing, I would like to say that in my experience in this work I have never seen a string of casing stick. It can happen, however, and unnecessary chances should not be taken.

Pump Pressure Important

As one purpose of progressive circulation is to keep circulating pressures at a minimum, it is important to start the mud pumps with motors idling (Fig. 1) and watch the pressure gage carefully. If circulation does not

begin at a reasonable pressure, the casing should be moved downward slowly. This will aid in setting the annular fluid in motion as well as change the position of the casing collars and centralizers in relation to the well bore.

The length of time to circulate at each point is dependent upon hole and casing diameters, pump capacity, casing depth, and the condition of the drilling fluid. Frequent testing of the drilling fluid is the best means for determining when to stop circulating. By measuring the mud weight and viscosity frequently, one can tell when the old heavy mud is replaced with fresh mud. (Fig. 1)

Testing the Mud

The heavy mud usually brings a large quantity of cuttings with it, and, when the volume of cuttings returns to normal, the time of circulation has probably been sufficient.

This is not as reliable, however, as checking the drilling mud properties periodically. The mud pump pressure reflects the condition of the mud to a certain extent (also shown in Fig. 1), but this should not be relied upon entirely unless the pump speed is checked coincident with each pressure reading and the casing is held stationary for each reading.

When the casing string reaches the setting depth, a circulating period is begun for the purpose of cleaning embedded cuttings from the well bore prior to cementation. During this cleaning period, the casing should be moved upward and downward (reciprocated) a distance of 35 to 40 ft; beginning after circulation is started, and continuing until the operator is satisfied that the well bore is cleaned sufficiently.

The exact time that the well bore is in condition to receive the cement is a matter for conjecture, however, the weight indicator does reflect hole conditions and should, therefore, be watched closely. Under normal conditions while reciprocating the casing, the indicated weight of the casing string will decrease gradually on the upward stroke and increase on the downward stroke toward respective

TABLE 2. Weight indicator readings during casing reciprocation.

Remarks	Circulating Time, min	Drilling mud wt., lb/gal	Weight indicator reading, lb		
			Up travel	Down travel	Up-down difference
Begin final circulation at 8500 ft w/7′–26″ casing.	0	10.8	191,000	180,000	11,000
	10	10.8	189,500	180,000	9,500
	20	10.8	188,000	180,500	7,500
Casing reciprocated about 40 ft throughtout period.	30	10.8	187,500	180,500	7,000
	40	10.8	187,000	181,000	6,000
	50	10.8	186,500	181,000	5,500
	60	10.8	186,000	181,500	4,500
	70	10.8	185,000	182,000	3,000
	80	10.8	185,000	182,000	3,000

(b)—with mud weight decreasing:

Remarks	Circulating time, min	Drilling mud wt., lb gal	Weight indicator reading, lb		
			Up travel	Down travel	Up-down difference
Begin final circulation at 8500 ft w/26″ lb/ft casing.	start	10.8	191,000	180,000	11,000
	10	10.7	189,833	180,333	9,500
	20	10.6	188,667	181,167	7,500
Casing reciprocated about 40 ft throughout period.	30	10.5	188,500	181,500	7,000
	40	10.3	188,667	182,667	6,000
	50	10.0	189,167	183,667	5,500
	60	9.8	189,334	184,834	4,500
	70	9.6	189,334	186,334	3,000
	80	9.3	190,000	187,000	3,000

Calculations for changing weight indicator readings from constant mud weight to varied mud weight. (d_1)

W = weight Indicator reading d = Mud density

Displacement of 7in–26lb/ft casing = .3922 gal per lin ft

.3922 x 8500 = 3334 gal

$d_1 - 10.8 \times 3334$ = buoyance change

$W_1 = W$ — buoyancy change

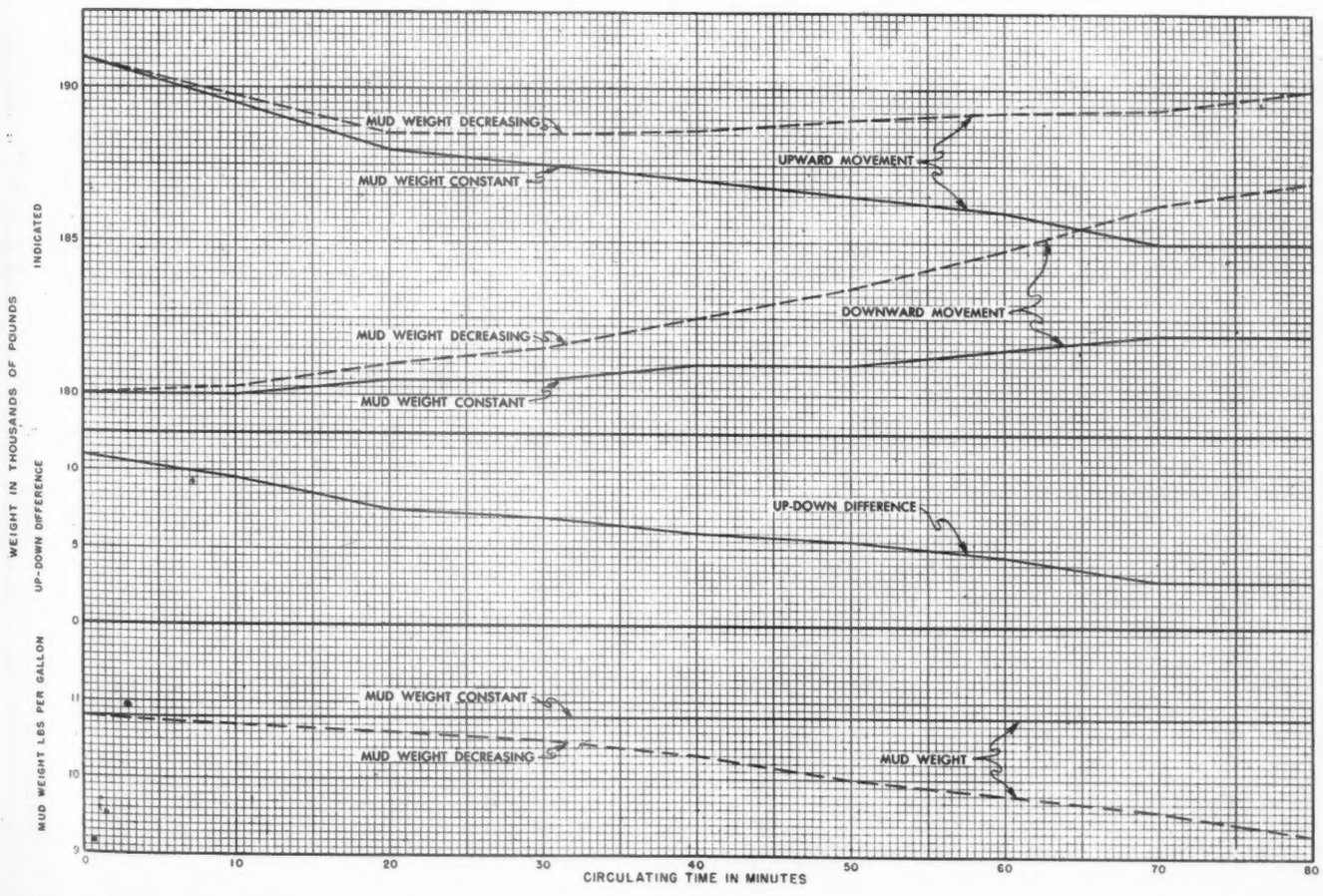
Example: $d_1 = 10.5$

$10.5 - 10.8 \times 3334 = -1000$ lb (buoyancy decreased by lighter mud)

$W = 187{,}500$

$W_1 = 187{,}500 - (-1000) = 188{,}500$

FIG. 2. Trends of indicated casing weights while reciprocating, time vs weight indicator and mud density.



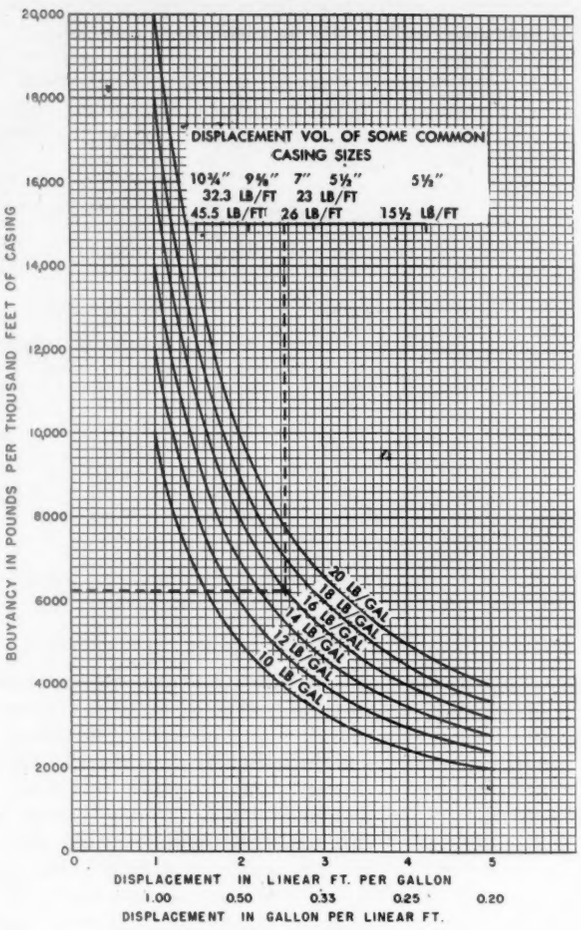

DISPLACEMENT VOL. OF SOME COMMON CASING SIZES
10¾" 9⅝" 7" 5½" 5½"
32.3 LB/FT 23 LB/FT
45.5 LB/FT 26 LB/FT 15½ LB/FT
20 LB/GAL
18 LB/GAL
16 LB/GAL
14 LB/GAL
12 LB/GAL
10 LB/GAL
BOUYANCY IN POUNDS PER THOUSAND FEET OF CASING
DISPLACEMENT IN LINEAR FT. PER GALLON
1.00 0.50 0.33 0.25 0.20
DISPLACEMENT IN GALLON PER LINEAR FT.

FIG. 3. Buoyancy vs casing displacement for various mud densities.

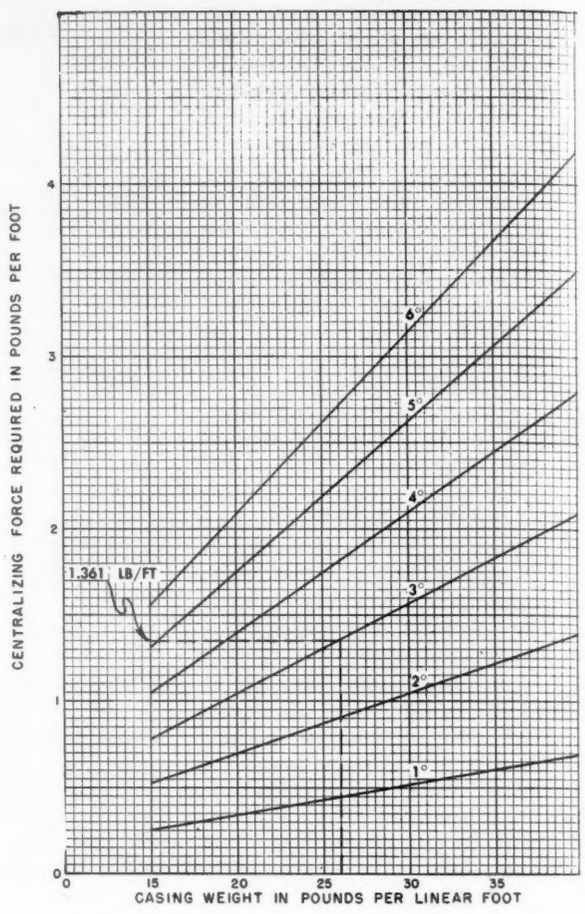


FIG. 4. Casing centralizing force required in holes from 1 deg to 6 deg from the vertical-cent. force.

minimum and maximum weights. The indicated weights themselves are affected by the density of the drilling fluid, however, and a lowering fluid density can cause the upward weight to increase continually rather than decrease.

Weight Difference Decreases

The difference between the upward and downward weights, however, should decrease steadily to a minimum as the hole becomes progressively cleaner regardless of fluid density changes. This is illustrated by a curve (Fig. 2) showing in solid lines the weight indicator readings that are normal for 8500 ft of 7 in.-26 lb/ft casing being reciprocated in 10.8 lb/gal drilling mud. The dashed lines show what might have happened to the weight indicator readings had the mud density decreased from 10.8 lb/gal to 9.3 lb/gal.

Notice that the density change would have had sufficient effect to completely reverse the normal trend of the upward weight indicator readings but that the difference between the upward and downward readings would have remained the same in both cases. Such changes in mud densities are not common, however, they do occur. The extreme has been used here to emphasize the point that the difference between the upward and downward weight indicator readings is more reliable as a gauge of hole condition than the readings themselves.

Fig. 3 is included here merely to show one way of quickly estimating the force of buoyancy caused by various mud densities. Without further remarks about how the operator satisfies himself that the well bore is sufficiently clean for cementing, he should bear in mind that the scratchers and centralizers are not indestructible and

TABLE 3. Effect of mud weight on buoyancy of casing strings.

Calculations	Casing displacement lin ft/gal	Casing displacement gal/lin ft	Buoyancy in pounds per 1000 ft of casing for various mud weight 10lb/gal	12lb/gal	14lb/gal	16lb/gal	18lb/gal	20lb/gal
Buoyancy = Vol. × mud weight	1	1.00	10,000	12,000	14,000	16,000	18,000	20,000
Volume in gal	2	0.50	5,000	6,000	7,000	8,000	9,000	10,000
mud weight in lb/gal	3	0.33	3,333	4,000	4,666	5,333	6,000	6,666
	4	0.25	2,500	3,000	3,500	4,000	4,500	5,000
Buoyancy lb/1000 ft = gal/lin ft × 1000 × lb/gal.	5	0.20	2,000	2,400	2,800	3,200	3,600	4,000

TABLE 4. Forces required to center casing.

Casing weight lb/ft	Degrees off vertical / Sine of angle	Force (lb/ft) required to center casing in holes off vertical 1 .017452	2 .034899	3 .052336	4 .069756	5 .087156	6 .104528
15		.262	.526	.785	1.049	1.307	1.568
20		.349	.698	1.046	1.395	1.743	2.090
25		.436	.872	1.310	1.743	2.179	2.613
30		.524	1.047	1.570	2.093	2.615	3.136
35		.611	1.221	1.831	2.441	3.050	3.658
40		.698	1.396	2.093	2.790	3.486	4.181

that excessive use of them during the final circulation period may hamper their effectiveness during cementation, the time when they are primarily needed.[1]

Changing Connections

When the final circulation period ends preparations for mixing and displacing the cement should be made without delay. Up to this point, circulation has probably been through a simple swage connection at the top of the casing string. This must be replaced with some type of cementing head.

TABLE 5. Weight indicator readings during casing cementing period.

Circulating time, min	Weight indicator readings, lb		
	Upward	Downward	Difference
0	185,000	182,000	3,000
10	186,750	183,750	3,000
20	188,750	185,750	3,000
30	188,750	185,750	3,000
40	188,750	185,750	3,000
41	188,750		
42		184,500	(4,250)
43	186,500		
44		182,500	(4,000)
45	184,250		
46		180,000	(4,250)
47	182,000		
48		177,750	(4,250)
49	179,750		
50		175,750	(4,000)
51	177,500		
52		173,500	(4,000)
53	175,250		
54		171,250	(4,000)

(4,000) Apparent difference when reading upward movement first—graph shows actual difference to be 3,000 lb.

As this change is being made, it is a good idea to insert a "bottom" plug to clean the drilling mud from the inside of the casing ahead of the cement slurry. Then, when the regular cement "followup" or "top" plug is released on top of the cement slurry, there should be no drilling mud for it to wipe off.

In many cases where the bottom plug was not used, the top plug has wiped off enough mud to displace all of the cement out of the casing and up the annulus a short distance.[5] This may be prevented without the use of the bottom plug by spreading the distance between the casing shoe and the float collar from two to five joints apart depending, of course, on the lengths of the casing joints and the depth to which the casing is being run.

Bottom Plug Advisable

Obviously, the use of a bottom plug is the simpler way to insure that the cement around the shoe is free from mud contamination; however, some operators are afraid that a malfunction of this plug might close the valve within the float collar and leave the batch of cement inside of the casing.

The use of a special collar with sealed ports that rupture at a predetermined pressure above the float collar allows a means of getting the cement into the annulus should the float valve become plugged. There would be no cement placed from the ports of this special collar to the casing shoe unless the hole depth would allow a temporary lowering of the collar to the casing point during placement of the cement.

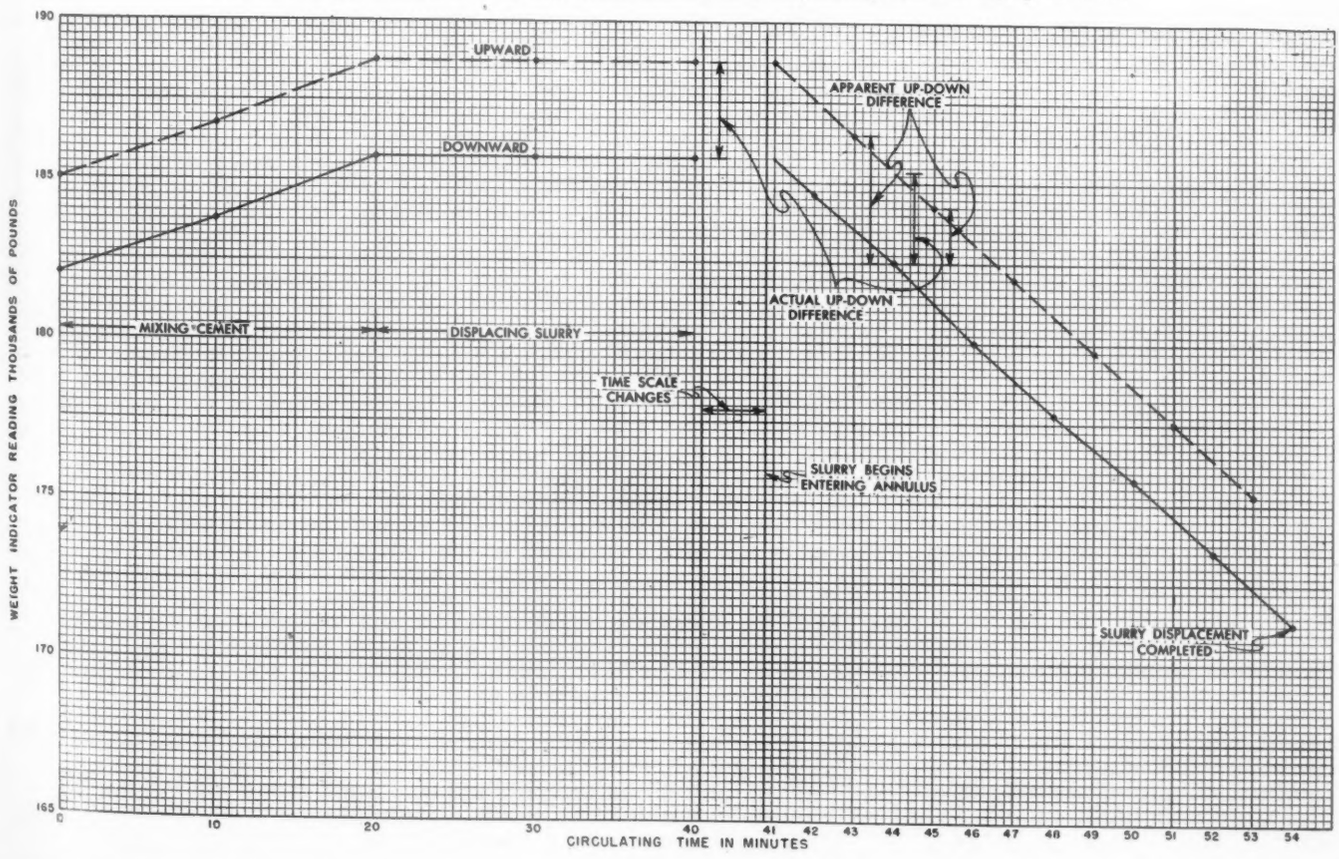
Cementing Calculations

While the cement is being mixed, spot checks of the slurry weight should be made to aid in arriving at a total slurry volume. When the slurry volume has been figured, displacement volume calculations should be made and converted to time (see example in Appendix II), so the arrival of the top plug at the float collar can be anticipated.

The casing should not remain stationary during the cement mixing time for reasons discussed earlier, however, it is not necessary to reciprocate the casing string the full stroke that was used to clean the well bore. It is better to use some system similar to that employed at the progressive circulation points. This prevents undue wear and tear on the scratchers and centralizers while keeping the casing string free.

The most important job to be done by the scratchers is performed as the cement is being placed, so, when the time for arrival of the cement slurry at the casing shoe is near, full, regular reciprocations should be started again. The scratcher is simply a wire

FIG. 5. Weight indicator reading while mixing and displacing cement slurry vs time.



brush designed to remove mud filter cake mechanically just ahead of (or after) the passage of the cement slurry.[1, 2]

Some operators put scratchers on their casing and then refuse to move the casing string during cementation. This, in my opinion, is pure folly and cement failures resulting from this practice should certainly not be charged against the scratchers.

Reciprocation of Pipe

While the cement slurry is being placed it is important for two additional reasons that the casing be kept in motion. A cement sheath is being placed on the wall of the well bore where mud filter cake has been formed, and, as the cement slurry does not possess the filter cake properties of drilling muds, a serious problem arises. A cement slurry exposed to a porous media will dehydrate rapidly. This accelerates the setting time, so the slurry should be agitated continually to prevent "flash" setting and "freezing" of the casing.

The movement of the casing also aids in preventing channeling due to the stirring action of the scratchers and the increase in annular velocities on the downward stroke.[1] It is a good idea to explain these things to the driller who is running the draw works so that he will not tarry when the direction of motion of the casing is being changed. Throughout this final reciprocation and cementing period, the weight indicator should be watched diligently for any sign of the casing sticking.

The person responsibile for the job should be in a position near the driller at this time, too, so that immediate steps may be taken in case of an emergency. It is very important to have a man with experience on hand at this point as there are some natural variations in the weight indicator readings that might alarm an inexperienced person.

Fig. 5 shows how the indicated weight rises as the cement slurry is pumped into the casing and how it falls as the slurry reaches the annulus. The indicated weight falls exceptionally fast, because of the combined effects of losing the heavy slurry from the casing and gaining increased floatation.

Weight Indicator Readings

Due to this rapid change in the floatation effect, the weight indicator readings should be recorded for each upward and each downward movement of the casing as shown in Fig. 5. Here, as in the reciprocations before the cement was mixed, the difference between the upward and downward weights is the thing to watch. So long as this difference does not vary appreciably the casing is "free" and reciprocations should be continued until the cement is completely displaced.

Note in Fig. 5 that the numerical difference between the upward and downward weights changes (from 3000 lb to 4000 lb in this case) when the slurry enters the annulus, because of the difference in time between each reading. There is actually no difference in the up-down differential as the plat shows. It is important to know that this will occur, so as to save undue alarm.

In many instances, the casing has been reciprocated several minutes after the cement slurry is totally displaced. This extra period of scratching is probably beneficial in some cases, however, it is mentioned here not as a recommendation but to show that continuous movement of the casing should prevent its sticking. Fear of sticking the casing causes some operators to stop the reciprocations prematurely and rob themselves of some of the final effects of the scratchers.

Bibliography

1. G. C. Howard and J. B. Clark, "Factors to Be Considered in the Proper Cementing of Casing," *Oil and Gas Journal*, November 11, 1948, page 243.
2. Teplitz, A. J., and Hassebrock, W. E., "An Investigation of Oil Well Cementing," *API Drilling and Production Practices*, 1946.
3. Jones, P. H., and Berdine, Denis, "Factors Influencing Bond Between Cement and Formation," *API Production Practices*, 1940.
4. D. H. Stormont, "Casing Centralizers and Scrapers Aid in Eliminating Faulty Cement Jobs," *Oil and Gas Journal*, September 16, 1948, page 99.
5. Weber, George, "Cementing Method Designed to Prevent Cement Contamination in Casing," *Oil and Gas Journal*, February 26, 1948, page 134.
6. Teplitz, A. J., "Casing Cementing and Perforating Practices."
7. "Strength of Materials," Alfred P. Poorman, A.B., C.E., Professor of Applied Mechanics, Purdue University.
8. "Applied Mechanics," Alfred P. Poorman, A.B., C.E., Professor of Applied Mechanics, Purdue University.
9. Coberly, C. J., "Analysis of Casing Stresses and California Casing Practice," *API Bulletin*, 1930.
10. "Petroleum Production Engineering," by Lester C. Uren, University of California.

Appendix 1

For the purpose of making centralizer requirement calculations the following assumptions are made:

1. The pipe is stationary and in tension—being suspended from the surface.

2. The buoyancy effect of the drilling fluid on the unit weight of the casing is negligible.

3. The angle of deviation of the bore hole from vertical is constant over the distance considered.

4. The casing over the short length being considered can be treated as a continuous beam uniformly loaded.

Fig. A-1 illustrates the condition of a section of casing suspended in a bore hole a° from vertical. The centralizers holding the casing in the center of the hole are designated as Fc_1 and Fc_2. W is the unit weight of the casing acting vertically downward and w is the unit weight of the casing acting perpendicular to the axis of the well bore. L is the distance betwen the centralizing forces Fc_1 and Fc_2 in ft.

$$Fc_1 + Fc_2 + Fc_x = wD$$

Where:

D = length of casing to be covered with centralizers

When centralizers are equally spaced

$$Fc_1 = Fc_2 = Fc_x = \frac{wD}{x}$$

$$\text{and, } L = \frac{D}{x}$$

Where:

x = number of centralizing forces

w = W sine a (from Vector diagram in Fig. A-1).

When the overall length of casing to be centralized and the angle of deviation of the well bore are known, then the number of centralizers (of a given compressive strength, needed to center the pipe can be readily calculated.

Example: Assume 1000 ft of 7-in. 26 lb/ft casing is to be centered in a 9¾-in. well bore 3° from vertical with 250-lb. centralizers.

$$x = \frac{wL}{250} = \frac{26 \text{ sine } 3^\circ \times 1000 \text{ ft}}{250}$$

$$x = \frac{1361}{250} = 5.44, \text{ or } 6 \text{ centralizers.}$$

$$L = \frac{1000}{6} = 166.7 \text{ ft.}$$

Six 250-lb. centralizers have sufficient force to hold the weight of the casing in this case, but placing the centralizers 166.7 ft apart probably will not keep the casing away from the well bore at all points because of flexure. Table 6 may be used as a guide in determining the maximum distance between centralizers.

Appendix 2

Calculations to arrive at the approximate pumping time* required to:

(a) displace the cement slurry to the shoe,

(b) equalize the casing and annulus cement columns.

(c) displace the top plug to the float collar.

*The timing begins after the cement has been mixed and pumped into the cementing head.

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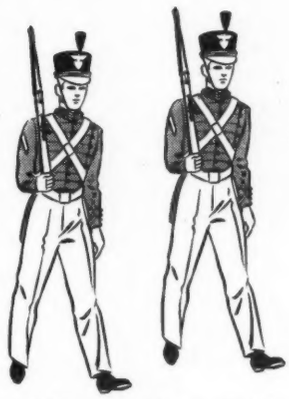

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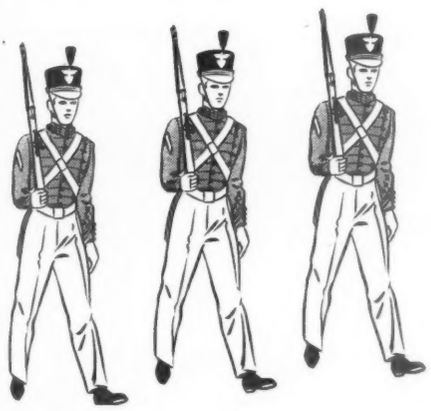

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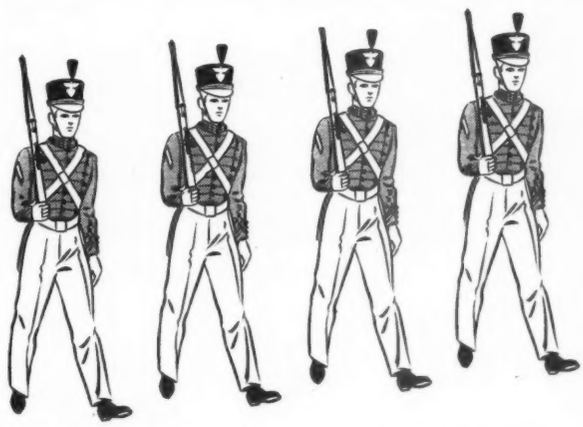

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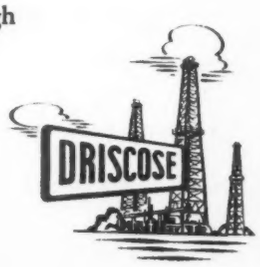

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Example: Assume the following conditions: 8500 ft of 7-in. 26-lb/ft casing in a hole of 9¾-in. average measured diameter. Mud pump with 6¾-in. liners, 16-in. stroke, 2-in. shaft, operating at 90 per cent efficiency—500 sacks cement mixed at an average weight of 15 lb/gal. Then from cementing tables† read and record

1. Slurry volume at 15 lb/gal = 1.28 cu ft/sack.
2. Capacity of 7-in. 26 lb/ft casing = .2148 cu ft/ft.
3. Capacity of annulus (7-in. casing and 9¾-in. hole) = .2512 cu ft/ft.

(a) $Ts = \frac{Vc - Vs}{C}$

Where:

Ts = Time in min required to displace the cement slurry to the shoe after the cement has been mixed and pumped into the cementing head.

Vc = Total casing capacity in cu ft

Vs = Total cement slurry volume in cu ft

C = Pump capacity in cu ft/min

then,

Vc = .2148 × 8500 = 1825.8 cu ft

Vs = 1.28 × 500 = 640 cu ft

C = 57.15 cu ft/min at 50 spm

and,

$Ts = \frac{1825.8 - 640}{57.15} = 20.74$ min

(Surface to casing shoe)

(b) $Te = \frac{Vc - Vse}{C}$

Where:

Te = Time in min required to equalize the casing and annulus cement columns

Vse = Volume cement in casing at equalization = d × .2148 where d is height of cement column in ft at equalization.

Vsa = Volume of cement in annulus at equilization = d × .2512

Vsa + Vse = Vs

.2148d + .2512d = 640 cu ft

$d = \frac{640}{.466} = 1373.3$ ft

Vse = .2148 × 1373.3 = 294.98 cu ft

$Te = \frac{1825.8 - 294.98}{57.15} = 26.78$ min

(Surface to equalization)

(c) $Ttd = Te + \frac{Vse - Vsf}{C_1}$

†Halliburton.

Where:

Ttd = Time required to totally displace slurry.

C_1 = 40.03 at 35 spm* (av).

Vsf = Slurry volume remaining between the float collar and shoe joint.

*Slower rate due to increase in pump pressure after equalization.

Assume float collar and shoe distance = 45 ft

Vsf = 45 × .2148 = 9.67 cu ft

$Ttd = 26.78 + \frac{294.98 - 9.67}{40.03}$

= 34.01 min

(Surface to total displacement)

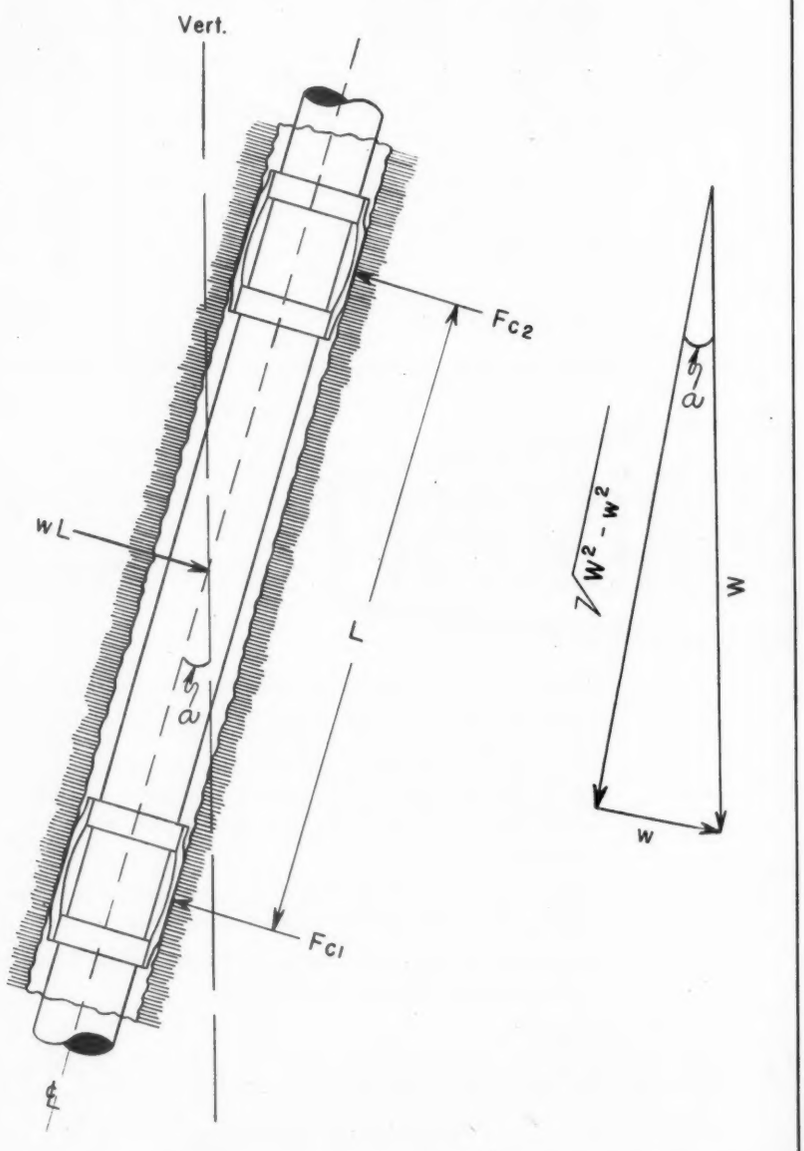
* * *

TABLE 6. Guide to maximum spacing of centralizer.

Casing		Hole deviation, degrees from vertical					
Size, in	Weight, lb/ft	1	2	3	4	5	6
5½	17 to 23	95	80	70	65	62	60
7	24 to 30	105	90	80	75	70	67
9⅝	40 to 47	125	105	95	87	82	80
10¾	40.5 to 55.5	130	110	100	92	88	83

This table is not applicable to sections of the well bore where the angle of deviation from vertical is changing. This condition and high angle holes require special calculations.

FIG. A-1. Cross-section of hole and vector diagram.



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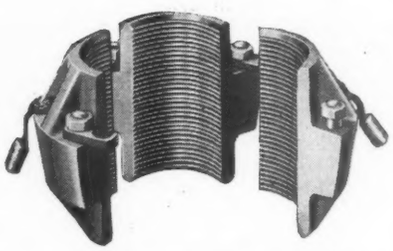

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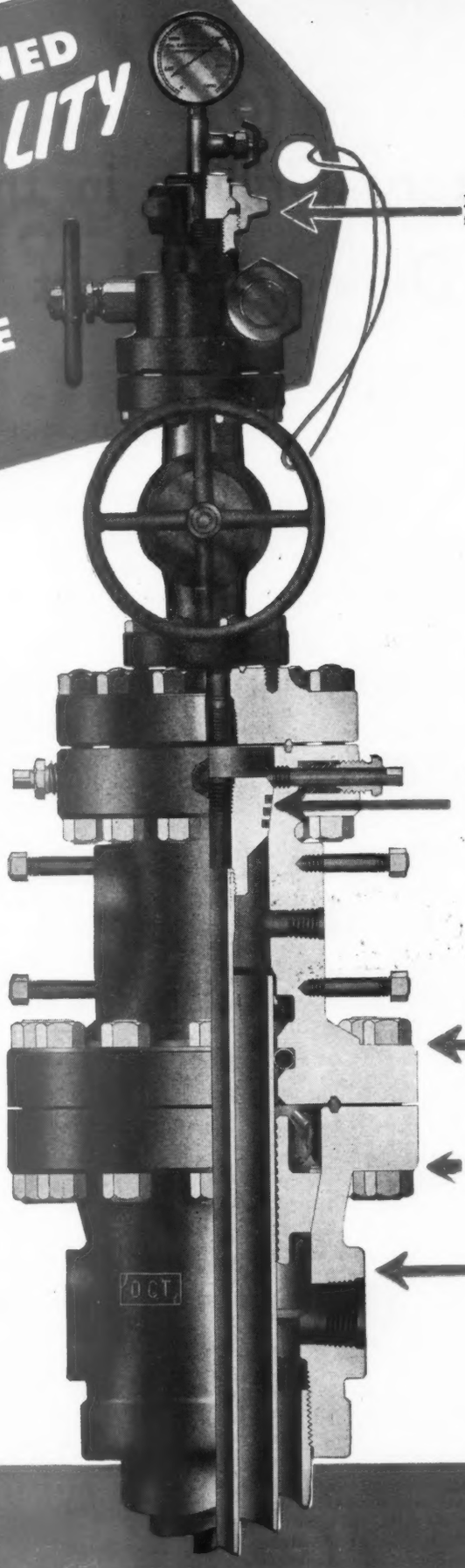

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EXCLUSIVE

Exploratory Drilling in the United States During the Last 11 Years

FREDERIC H. LAHEE*

SINCE 1936 the writer has been interested in compiling statistics on exploratory drilling for petroleum and natural gas. By "exploratory drilling" we mean both "rank" wildcatting and the more risky phases of searching for oil or gas by drilling on structures that are already producing. In this study we *exclude* all wells drilled in, or immediately adjacent to, producing areas, i.e., those wells drilled on units essentially proved for production by the adjacent drilling. Except in the case of the first article submitted, these statistics on exploratory drilling have been published each year in the June number of the Bulletin of the American Association of Petroleum Geologists, beginning in June, 1937. Previous to March, 1945, the figures were gathered through the cooperation of a group of interested friends of the writer. After March, 1945, a committee was organized within the Association for the purpose of collecting the statistics on exploratory drilling, and during the following years the methods for compiling and recording the data were carefully standardized and systematized.

The Committee on Statistics of Exploratory Drilling adopted the classification which had been used by the Petroleum Administration for War. This classification recognizes five different kinds of exploratory holes. First we have (a) the new-field wildcats (rank wildcats) drilled far from producing areas in search of oil or gas on structures not previously producing. Next we have two kinds of holes which are drilled on producing structures, but *ouside* the limits of proved acreage. These are (b) the outposts, drilled with the purpose and expectation of extending, for a considerable distance, the pool already partly developed; and (c) the new-pool wildcats, drilled in search of new pools or reservoirs on structures on which production has already been developed. Finally, we have two more

*Geological and Research Counselor, Sun Oil Company, Dallas, Texas.

TABLE 1. Statistics on exploratory holes and footage drilled, and on average depth of exploratory hole in United States.†

Year	A Successful exploratory wells: Total producers*		B New-field discovery wells	C B is what per cent of A	D Number of dry exploratory holes	E Total exploratory holes A+D	F Number of dry exploratory holes drilled for each producer (D/A)	G Total footage in successful exploratory holes	H Total footage in dry exploratory holes	I Number of feet drilled in dry holes for each foot in producers(H/G)	J Total exploratory footage (G+H)	K Average depth of exploratory hole (J/E)
1938	294 oil 75 gas	369	226	61.2	2,269	2,638	6.14	1,526,557	7,333,927	4.8	8,860,484	3,359
†1939	226 oil 49 gas	275	175	63.6	2,427	2,702	8.81	1,118,420	7,674,677	6.86	8,793,097	3,331
1940	302 oil 64 gas	366	241	65.8	2,672	3,038	7.30	1,411,550	8,842,418	6.26	10,253,948	3,375
1941	416 oil 60 gas 27 cond.	503	282	56.1	2,761	3,264	5.48	2,047,377	9,567,708	4.66	11,615,085	3,559
1942	410 oil 53 gas 29 cond.	492	268	54.5	2,720	3,212	5.52	2,158,707	9,965,287	4.62	12,123,994	3,775
‡1943	530 oil 147 gas 37 cond.	714	400	56.0	3,294	4,008	4.61	2,936,266	12,783,447	4.35	15,719,713	3,922
1944	709 oil 149 gas 86 cond.	944	342	36.2	3,852	4,796	4.08	4,382,220	15,843,667	3.61	20,225,887	4,217
1945	840 oil 274 gas 100 cond.	1214	352	29.0	4,399	5,613	3.62	5,501,702	17,528,564	3.19	23,030,266	4,103
1946	762 oil 272 gas 103 cond.	1137	333	29.3	4,616	5,753	4.06	5,286,711	16,880,850	3.19	22,167,561	3,854
1947	981 oil 325 gas 72 cond.	1378	394	28.6	5,397	6,775	3.90	6,166,163	20,227,185	3.28	26,393,348	3,896
1948	1098 oil 255 gas 110 cond.	1463	501	34.2	6,550	8,013	4.5	7,179,450	25,561,647	3.56	32,741,097	4,086

*In the years 1938 to 1940 inclusive, condensate-plus-gas wells are included with gas wells. After 1940 gas wells and condensate-plus-gas wells are listed separately in this table.
†Kentucky statistics were added for 1939 after publication of that year's report.
‡Statistics for New York, Pennsylvania, and Eastern Ohio have been included here in 1943, although they came in too late for publication in the 1943 report.
*Reprinted from Bulletin of the American Association of Petroleum Geologists, June, 1949.

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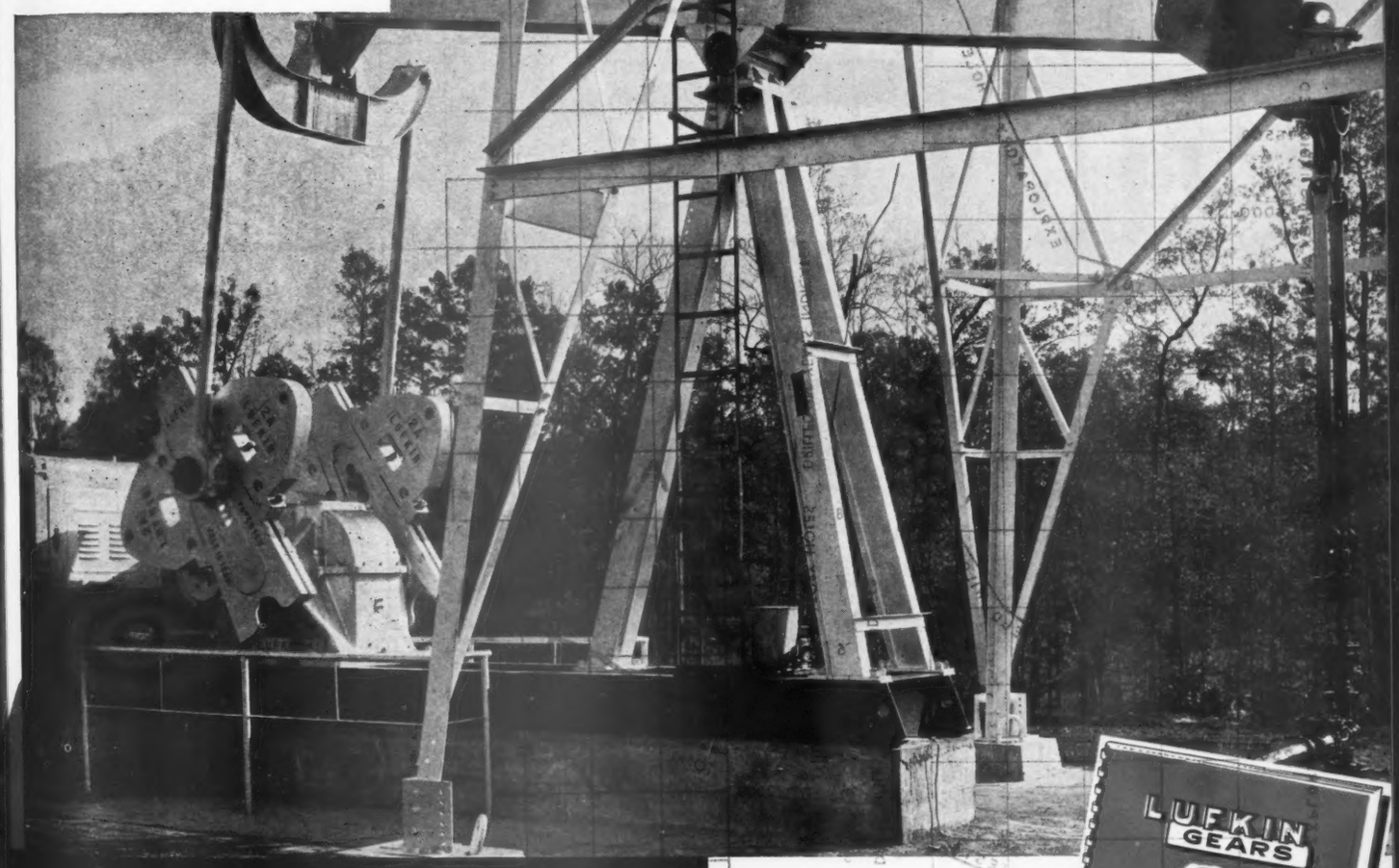

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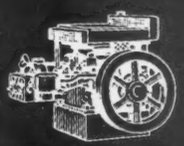

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types of hole, both drilled *within* the proved area of a pool already partly (or wholly) developed. One of these types (d) is drilled in search of a new pool *below* the deepest producing reservoir, and the other (e) is drilled in search of a new pool *above* the deepest producing reservoir. These five classes are conveniently grouped under three heads: (1) new-field wildcats (a, above), (2) new-pool tests (including c, d, and e, above), and (3) outposts (b, above).

In Fig. 1† we have graphically shown the number of each of these three classes of holes, and also the total number of exploratory holes, drilled in each of the years 1944 to 1948, inclusive. We cannot carry this comparison earlier than 1944 because we lack the necessary data. Observe that the curve for total exploratory holes rises steeply and almost uniformly through the five-year period, but that the marked increase in new-field wildcat drilling did not begin until in 1947. The rise in the former curve from 1944 and 1945 was due to increased activity in the less risky types of drilling (outposts and new-pool tests). Also it is interesting to observe that about as many outposts as new-pool tests were drilled each year, and that the total of these two groups was always somewhat less than the number of the new-field wildcats.

Fig. 2 covers a period of 11 years. It shows the slow increase in exploratory drilling in 1938 to 1941, inclusive, the slight drop in 1942, and the greatly increased pace of such drilling from 1943 to 1948, inclusive. The dashed line indicates the ratio between successful and unsuccessful exploratory holes. Thus, in 1945 there were 3.6 times as many dry holes as there were successful holes. Since 1945 this ratio has been nearly constant (between 3.62 and 4.47) in spite of the great increase in exploratory drilling during the same period.

†All the data used in constructing the graphs in this paper (Figs. 1 to 4) were taken from our annual reports on exploratory drilling published in the Bulletin of the AAPG.

FIG. 1.

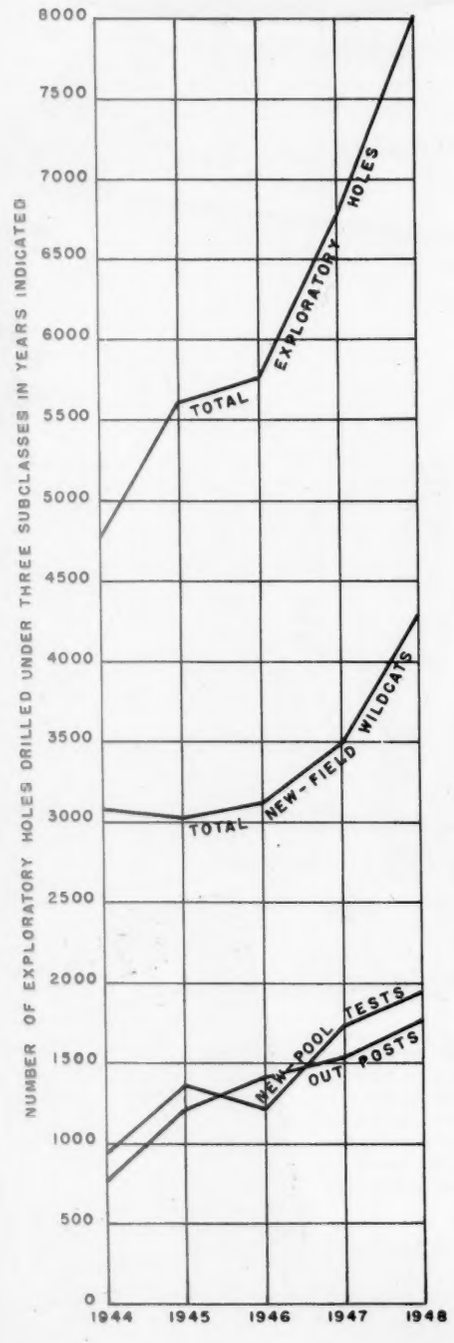

FIG. 2.

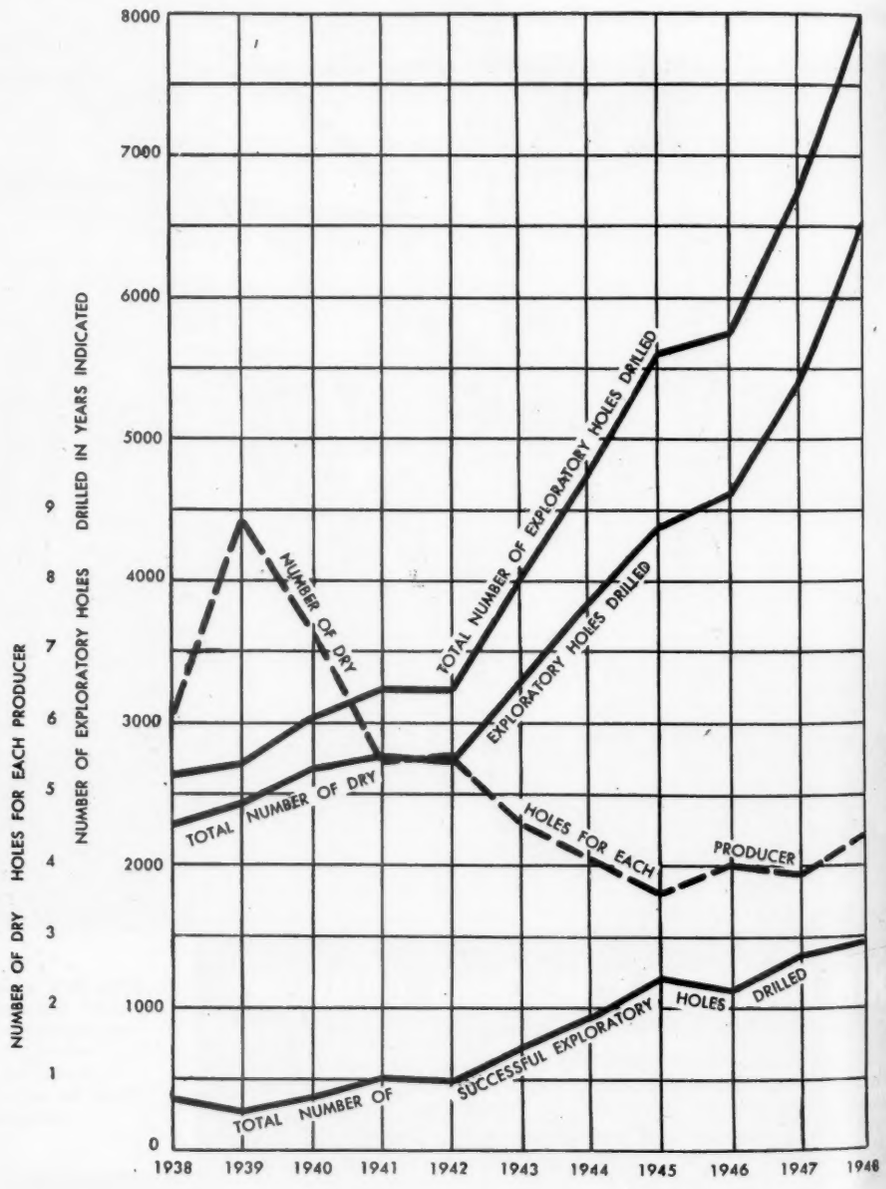

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FIG. 3.

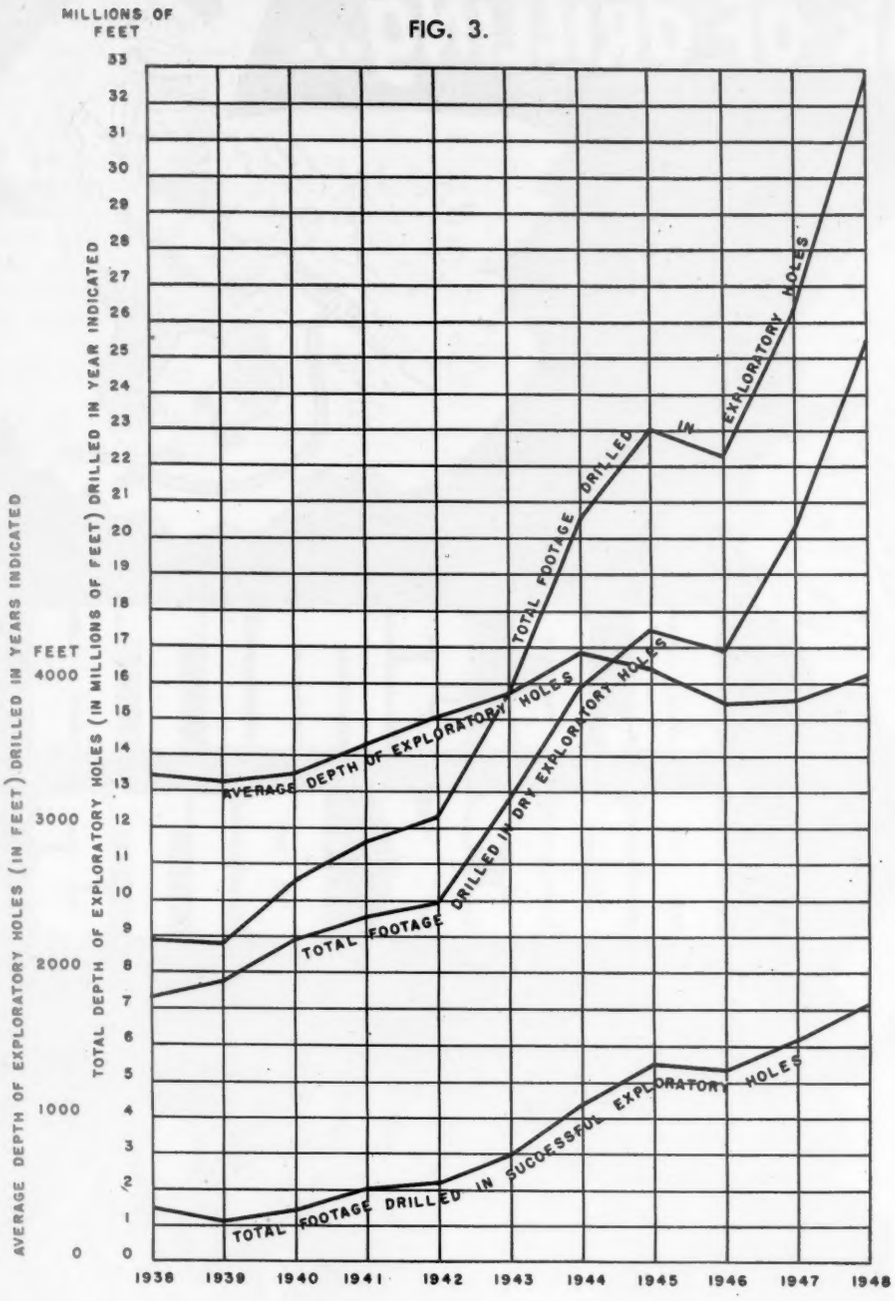
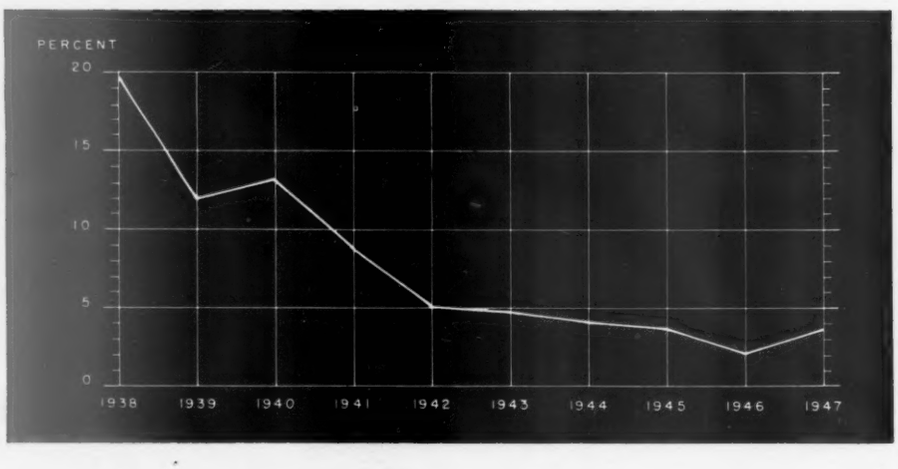


FIG. 4. Percentage of major discoveries among all discoveries by new-field wildcats in the year indicated. The major discoveries were those having an estimated total ultimate yield, or recoverable reserve, of 10 million barrels, or more.



In Fig. 3 is shown the total footage drilled (1) in all exploratory holes, (2) in all those which were successful, and (3) in all those which were dry. Note that the average depth of all the exploratory holes increases from 1939 until 1944, then decreases again through 1947 and 1948. The peak (greatest average depth) was reached in 1944.

Considering only the new-field wildcats (rank wildcats), we see by Fig. 4 that in general there has been a decrease in the relative number of major discoveries, i.e., discoveries of fields with an estimated total ultimate yield of 10 million barrels, or more, from 1938 to 1947. A slight improvement was shown in 1947, compared with 1946. This curve, in Fig. 4, has been carried only through 1947 in order to provide more than a full year of development history on which to base the estimates of total ultimate yield.

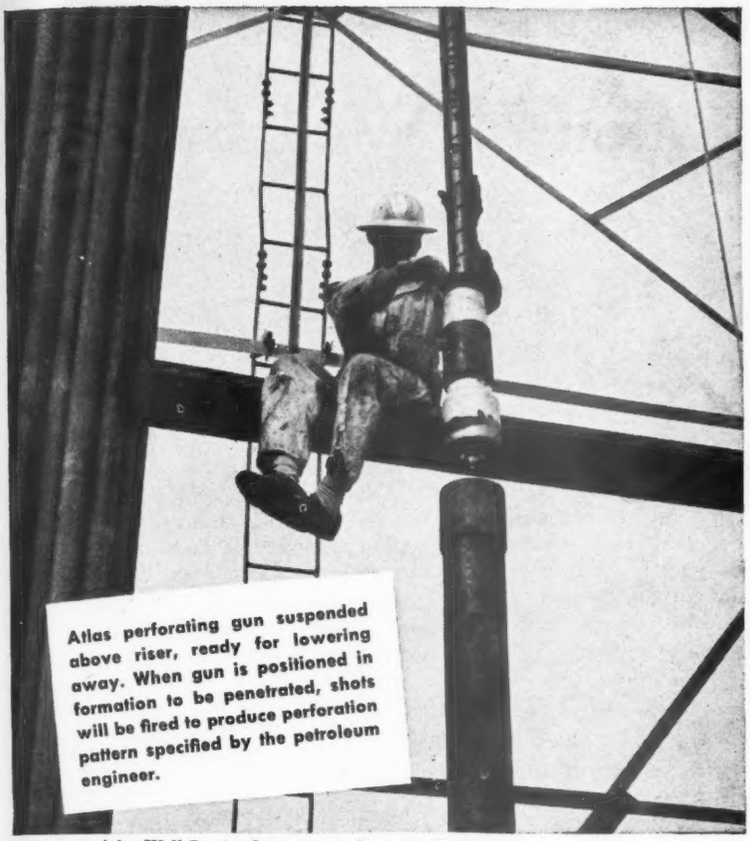
In concluding this brief summary of the exploratory drilling accomplished in the United States in the last 11 years, there are several points which we wish to emphasize.

First, this annual review, as provided by the Committee on Statistics of Exploratory Drilling, of the American Association of Petroleum Geologists, is of recognized importance and value to the industry, to the government, and to the public. It should be continued in the years to come. For its accomplishment, complete adoption of our method of classification by the industry would be of great assistance to the men who gather the data. This classification has been widely accepted, but there are still some organizations which resist adopting it. Clearly, the best results for drawing analogies can be obtained by using only one system.

Second, it seems evident that while the barrels of newly discovered reserves may be increased by increase in exploratory drilling, the ratio of successful to unsuccessful holes does not reveal much change. On the other hand, the ratio of major discoveries to minor discoveries shows a marked tendency downward.

Third, all those concerned with the industry should bend every effort toward making the dry exploratory holes yield a maximum of information since they are not yielding oil or gas. When one considers how immense is the amount of money expended in the drilling of all these dry holes, it is deplorable if they are not studied in every useful way possible, thus to learn more and more of the subsurface geology for the purpose of carrying on the search for more petroleum.

* * *



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as centering rings . . . *to hold gun in center of casing for effective perforating.*

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Sampling and Examination of Well Cuttings*

JOHN M. HILLS†

Abstract

Samples of well cuttings are one of the chief sources of information concerning the formations of the subsurface in the Mid-Continent and Permian basin areas of the United States. By careful use in applying the methods of collecting and preparing these samples as described in this paper, it is possible to obtain cuttings samples which are truly representative of the formations penetrated. By microscopic examination of these samples, it is possible to prepare descriptions and plotted logs which give an accurate picture of the rocks penetrated. These logs can be correlated so as to reveal the stratigraphic conditions in the subsurface and trace time horizons through various facies variations of the subsurface formations. These time horizons can be used in the structural interpretation of the region.

Detailed descriptions of cuttings samples from pay sections can be used, by methods outlined in this paper, in making estimates of oil and gas recovery from a field, in reservoir studies, and in guiding well remedial work.

Introduction

WHILE the techniques described in this paper have been learned during 14 years of subsurface work, the writer does not wish to give the impression that they are original with him. They are rather the results of many years experience of hundreds of geologists engaged in cuttings sample work, which are summarized especially for the benefit of those entering the profession or setting up subsurface departments in other regions.

Well cuttings are the source of most subsurface data obtained in the Mid-Continent and Permian basin areas of the United States. The collection and examination of samples of these well cuttings are highly organized and important techniques. In fact, in most holes in this province, well cuttings are the only reliable source of data concerning the formations penetrated. Logs made by experienced cable-tool drillers are very useful, but under present conditions these are rare. It is usual to find the drillers' log made by an inexperienced or uninterested rotary driller. Such a log gives only a general idea of the formations drilled, especially in areas where there is a distinct formation change between wells.

Of all the methods of obtaining information concerning rocks cut by the drill, cores are probably the most reliable. In soft unconsolidated formations these cores can be taken rapidly and with comparatively little expense, by means of a wire-line core barrel. However, in the Mid-Continent and Permian basin areas most of the rocks are well lithified and many are extremely hard. For this reason wire-line core bits wear out rapidly and cores are usually obtained by use of conventional core barrels which are capable of cutting a maximum of 20 ft at one time. Naturally this makes complete coring extremely expensive especially in deep holes. Recently a new technique of coring with diamond-studded core heads has been developed which may lead to much more extensive coring. It is possible that in the future as much as 100 ft of core may be taken at one time by means of a diamond bit without coming out of the hole. This may render practicable coring of complete sections of deep holes.

Electrical Logs and Radioactivity Logs

Electrical-resistivity and self-potential logs have almost supplanted cutting samples and cores in areas where the stratigraphic section is shale and sand and where salt beds do not contaminate the drilling mud. However, in areas where the section is composed of several kinds of rock, especially where limestone and anhydrite are abundant, electrical logs must be used with sample logs since the lithologic variety and high resistance of the rocks introduce many unknowns into the interpretation of the log. Thus, it is impossible to solve the problem without a sample log which will enable one to eliminate many of the possible solutions.

In limestone reservoirs it is very difficult to recognize the fluid content of the reservoir rock by use of electrical logs without additional information from testing the well, because the high resistivity of the limestone and the sulphur water commonly present mask the resistivity effects of the other fluids in the formation. However, electrical logs are useful for correlation in local limestone reservoirs where the section is well controlled by logs from sample cuttings. One fact that should be remembered in using electrical logs is that rock-salt beds cut by the bit cause a salty mud with a very low electrical resistance, that results in a featureless self-potential curve which is useless in making correlations.

Radioactivity logs are also useful as an auxiliary to sample logs. Here, also, a wide variety of rock and fluids in the stratigraphic column results in several possible interpretations for the curve, and a sample log is necessary for the correct solution. Radioactivity logs are sometimes very useful in logging old wells that have already been cased off on wells where mechanical difficulties have prevented taking a representative set of cuttings. Radioactivity neutron logs are probably more useful than resistivity logs in indicating a fluid zone, but it is not possible from the neutron log alone to determine whether the fluid content of the formation is oil or water.

Thus, in areas where consolidated formations are encountered, examination of well cutting samples is generally the easiest and least expensive method of detecting changes in the formation and determining the stratigraphic section penetrated by any well. Much subsurface geologic work depends on the collection of representative samples of the formation penetrated, describing these samples accurately, and plotting the description so that the sections in different wells may be correlated.

Cable-Tool Samples

The collection of cuttings samples from cable-tool wells presents com-

*Bulletin of the American Association of Petroleum Geologists, Vol. 33, No. 1 (January, 1949), pp. 73-91, 7 figs.

†Consulting geologist, Midland, Texas. The writer is especially indebted to W. D. Anderson, who taught him the fundamentals of sample examination; to William Y. Penn for the pictures of porosity; to E. Russell Lloyd who suggested the writing of this paper and has been generous with help and suggestions; and to John Emery Adams and W. W. West who kindly read and criticized the manuscript.

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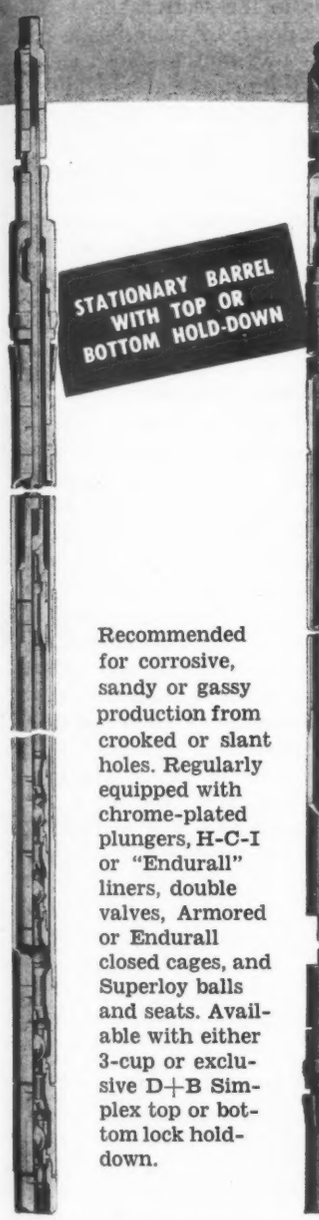

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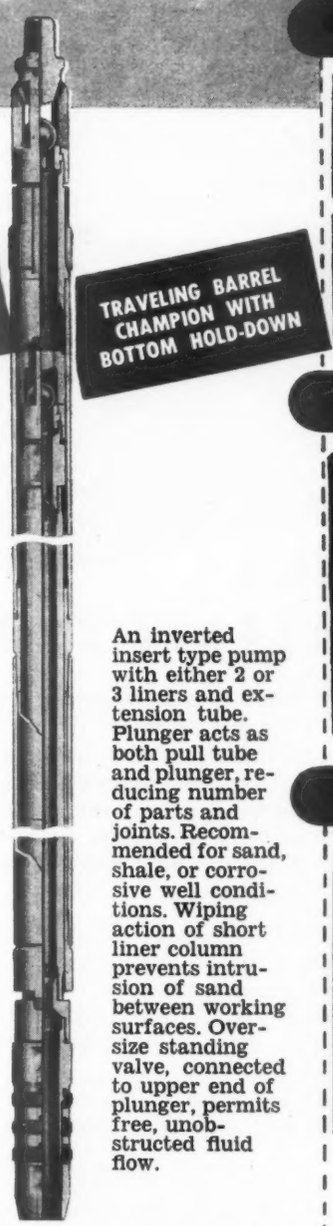

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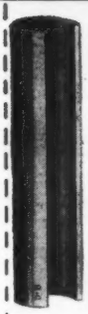
LINERS



Hardened cast iron (H-C-I) liners for ordinary pumping, or stainless steel "Endurall" liners for severe service, are normally supplied with D+B Rod Liner Pumps. All D+B liners are centrifugally cast to provide a uniform dense structure free from impurities. They are honed to a mirror-like finish and have a precisely controlled hardness for maximum wear resistance. Standard and Armored liners are available.

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paratively few difficulties. The samples should be collected from the first bailer after each run of the bit, in a bucket hung at the end of the dump box. These samples should be washed enough to carry off all mud. They should be put in cloth sacks, then labeled with the name of the company, name of the farm, number of the well, location, and depth of sample. The hole is, of course, bailed clean each run of the bit and only occasionally are cavings a problem in consolidated formations.

In drilling bentonitic shales, quicksands, or conglomerate, the hole ordinarily caves readily so that the samples are not entirely reliable. When high pressure gas is encountered, the hole is commonly filled with water or light mud to control the gas. This ordinarily results in samples being finely ground and much material is washed off the upper parts of the hole, which contaminates the samples. The same condition results from drilling ahead in a hole full of water coming from the formation. Generally, under these conditions, pipe is run before much hole is made so that the number of poor samples is comparatively small. Where wire line or tools have been lost in the hole and must be drilled up, some samples contain large amounts of iron. This can be removed by means of a magnet and the residue of the sample examined. Surface rock and other materials sometimes are thrown into the hole in attempting to straighten it.

The problem of checking the depth at which samples are taken is not critical with cable tools, since the depth is checked by sand line on the bailer after each run. However, important datum beds in the section should be checked for depth by stringing in the sand line or by running a steel measuring line. Cable-tool samples differ from rotary samples by the general flaky character of the harder formations and by the polishing and rounding of many cuttings from attrition due to turbulence set up by the bit, and the irregular intervals at which they are taken, since the length of bit runs are determined by the character of the formation and mechanical factors.

Rotary Samples

The collection of rotary samples presents many more difficulties than the collection of cable-tool samples and for many years it was considered impossible to obtain reliable samples by this method of drilling. It is still difficult to obtain representative samples from rotary holes in unconsolidated formations, but a technique has been worked out whereby representative samples can be obtained in consolidated formations. These samples are taken from the returning fluid stream at regular intervals. The sample interval is usually 5 or 10 ft, but may be as small as 1 ft or as large as 30 ft. The chief problems in collecting samples of rotary cuttings are to prevent contamination with upper beds, prevent powdering of the sample, prevent loss of the sample, prevent elutriation, to obtain correct depth measurement, and to wash and properly dry the samples.

Contamination From Upper Beds

Contamination from upper beds is the chief problem of collecting rotary samples. In the early days of rotary drilling before mud building was fully understood, the walls of the hole were poorly plastered and unstable. Thus, the samples contained large amounts of extraneous material. The practice of considering any new material appearing in the samples as composing the entire content of the formation drilled then became general and by any other material was believed to be cavings. At present, however, the treatment of rotary muds has advanced so that usually a properly mudded rotary hole caves very little

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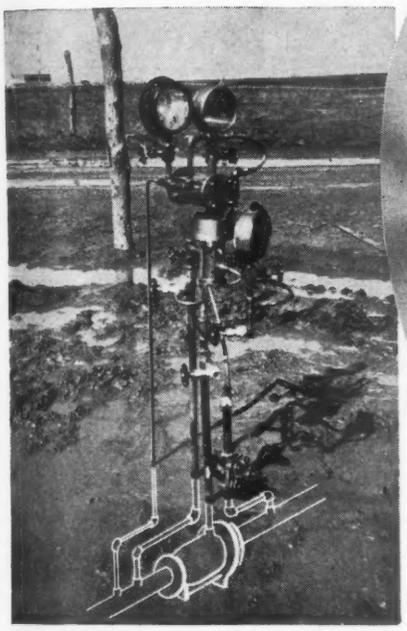

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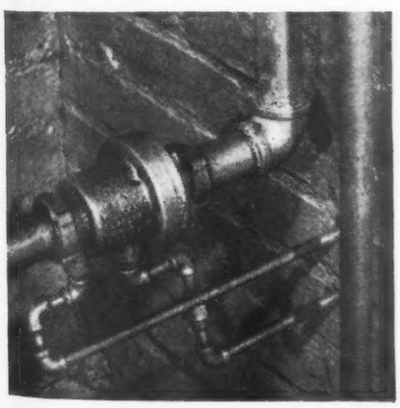

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and the percentage content of the sample may be taken as representative of the types of rock in the interval covered. This enables the geologist to follow very closely the lateral gradations in the section.

It should be emphasized that the geologist must work with the drilling superintendent to insure the maintenance of proper mud in the hole not only for the sake of drilling progress, but also for the securing of representative cuttings samples. The mud must have a gel strength and viscosity sufficient to bring the cuttings to the surface without recirculation and regrinding. It must be also capable of cushioning the impact of the drill pipe against the walls so as to prevent powdering of the samples. Once on the surface, the mud should be run through pits sufficiently large to insure settling of all the cuttings so that they will not recirculate. A shale shaker will insure complete separation of the larger cuttings and the mud.

Powdering of Cuttings

The powdering of the sample to a size too small to be examined effectively under the binocular microscope is largely due to poor mud which allows regrinding of the sample by the bit and powdering by whipping of the drill pipe against the walls of the hole. When extraordinarily large cuttings are needed for analysis of porosity and permeability or for other purposes, it is helpful to circulate in reverse of the usual manner, that is, to pump the mud down between the casing and drill pipe and up through the drill pipe. This results in higher mud velocities returning through the drill pipe which brings larger cuttings from the bottom as soon as they are chipped off by the teeth of the rock bit. Some of these cuttings are $\frac{1}{2}$ — $\frac{3}{4}$ in. across.

Reverse circulation is especially useful when drilling into low-pressure formations, by using oil as drilling fluid as it prevents any of the fine oil-borne cuttings from plugging the pores of the formation. In regular circulation with oil, the low viscosity of the oil will not carry out the cuttings and they are commonly reground to a fine putty-like mass which is useless for examination and has a plugging effect on low-pressure pays. Of course, reverse circulation is not necessary in high-pressure gas or oil pays since the high pressures tend to increase the velocity of the circulating fluids and carry the cuttings out of the hole. The advantages of using a water-free drilling fluid in low-pressure oil pays are combined with the advantages of a high-viscosity mud in carrying out the cuttings and cleaning the formation in oil-base muds recently developed. With these muds it is not necessary to use reverse circulation to obtain cuttings large enough for visual examination. However, since methods have been recently developed for determining porosity and permeability from extra large cuttings obtained by reverse circulation, this method undoubtedly still will be used to some extent in pay sections.

Loss of Cuttings

Loss of cuttings samples is due to two chief causes: lost circulation, and blowouts. Both of these are primarily mud problems. Lost circulation is caused by either too high water loss in the mud or by excessively heavy mud which overcomes the formation pressure of a porous or fractured bed so that the mud enters the pores or fractures. The cuttings are then carried into the porous beds and may not ever be recovered unless the well is completed in this zone and the cuttings come out later with the oil. Blowouts are caused by unexpectedly high formation pressures or by carelessness in handling the mud. The cuttings are blown out of the hole and not recovered.

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● Increased cleaning range; handles muds at full discharge, or deep-hole strings.
● Constant pressure mud-spray system . . . drum screens cleaned without water.
● Constant drum speed regardless of mud flow.
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In full step with the industry's swing to "packaged" engineering! The motor, the spray pump, the rotating pulley and gear, and the Sample Machine are centralized in one end-section for easier servicing and control. This "power package" has blasted previous performance standards for shale separators, and that goes for all types! Electric power maintains constant speed regardless of the mud inflow; this is the machine you've heard about, that cleans the drum screens without water. By pressure spraying screens with clean mud from the flowage, there is no alteration to the mud, and that means no loss due to hold-up and replacement. Write Thompson today for full specifications.
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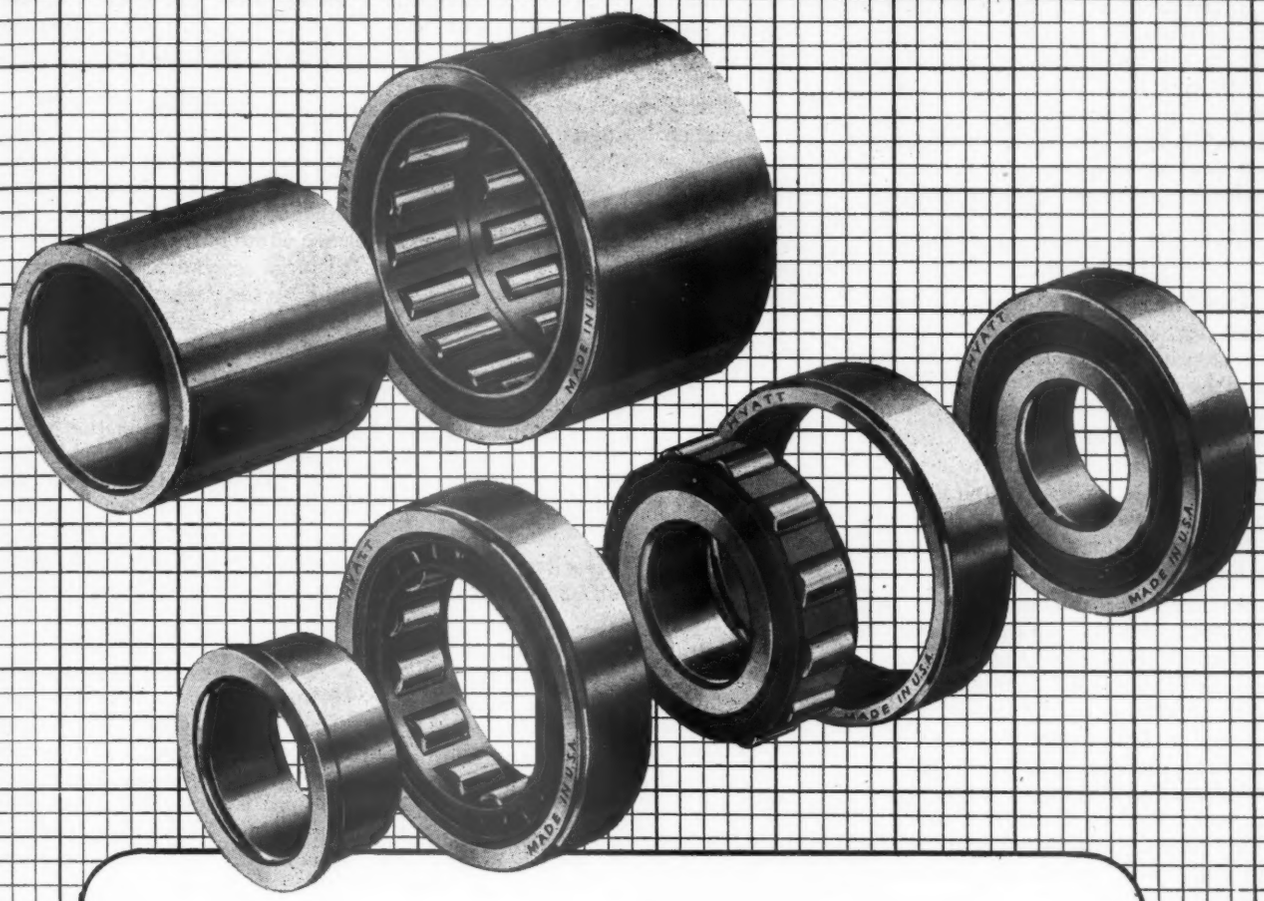

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HYATT ROLLER BEARINGS

Elutriation

Elutriation or separation of the coarse from the finer part of the sample by the upward movement of the circulating fluid is due to the use of mud with low viscosity and gel strength. In a good mud the cuttings are held in suspension and there is little change in the relative position.

Methods of Obtaining Correct Depths

Obtaining proper depth measurement for rotary cuttings is another major problem. The depth of the well must be checked often either by steel measuring line or by measuring the drill pipe under tension. Attention must be given constantly to see that the crew catches the samples at the proper intervals and that they do not anticipate the sample by filling several sacks at one time.

A great help in assuring correct sample depth is to have the driller keep a record of the drilling time on a form, such as Table 1. Each interval, 1, 5, or 10 ft, depending on the importance of the section, is shown on this sheet with the time drilling began, the time it ended, the time taken out for mechanical work, and the net time drilling. These intervals are usually marked on the kelly with grease or chalk and checked by the pipe measurement each time the kelly is drilled down to the derrick floor. In addition to assuring the correct depth of the samples, the drilling time gives a very valuable clue to the nature of formations penetrated as the time of drilling has a very close correlation with the lithologic character of the formation. This drilling time also may be taken with a mechanical device.

In pay sections where the exact measurements are very important or in deep holes where the cuttings take a long time to come to the surface, samples should be labelled with the depth at which they are actually cut rather than the depth of the well at the time they come to surface. This is accomplished by placing some easily identifiable substance, such as rice or corn in the drill pipe at the derrick floor when making a connection, and measuring the time required to bring the substance around to the shale shaker or return pipe. If regular circulation is being used, it can then be calculated from the pump pressure and volume handled how long the mud requires to go from the derrick floor through the drill pipe to the bit, and this subtracted from the total return time gives the time necessary for the samples to come from the bit to the surface. Unless it is known that the hole is in extraordinarily good shape with no washed-out places, it is not satisfactory to calculate the return time from the bit by mud volume and velocity, because some eddying and consequent lowering of the mud velocity takes place in all washed-out places. If it is not possible to determine the sample return time from experimental methods of calculation, a rule of thumb is that under ordinary mud pressure with 7- or 8-in. hole, it will take cuttings about 10 min per 1000 ft to return from bottom.

After the return time of the sample is determined or estimated, each sample should be caught that length of time after the appropriate depth mark on the kelly reaches the rotary table. An easy way to do this is to place on the drilling-time sheet the time each sample should be caught. This is done by adding the return time in minutes to the time at which the given mark is down to the rotary table. This method will eliminate lag in the samples and should make the sample log correlate very closely with the drilling time and with the electrical log.

Catching Samples

There are many ways to catch representative samples from the returning mud stream. The rotary shale shaker of the Thompson type has become very common in recent years. This is a large cylindrical screen through which the returning mud stream passes. The screen is turned by a water wheel moved by the mud stream. Attached to the large screen is a much smaller screen with fine mesh through which a portion of the main mud stream is diverted, off which comes a small portion of the cuttings which is collected in a box at the end of the screen for visual examination. This type of screen has the advantage that it requires no outside power to operate it, and it catches a representative sample of the cuttings without any further attention from the operator or crew. However, unless a very fine screen is used on the sample catcher, it will not catch all the fine sands. In some formations the mud will not wash out of the cuttings without use of an excessive amount of water which renders it unsuitable for use with low-water loss muds.

Another important type of screen commonly used is the vibratory shaker. In this device the mud stream passes across a vibrating screen. The mud passes through the screen into the pits while the cuttings are vibrating off into another receptacle. In consolidated formations good samples can be taken by placing a narrow box under a part of the end of the vibrating screen so that a representative portion will fall into this box. However, this screen is open to the same objection as the Thompson machine in formations consisting of fine sands, since the fine sand tends to pass through the screen and not be caught in the sample.

The simplest and possibly most reliable sample-catching device (Fig. 1) consists of a small-diameter nipple welded to the bottom of the mud return line with a 1½-in. or 2-in. line running to a box about one foot by one foot by three feet with a removable gate about six inches high in the end. In this box a representative portion of the cuttings is collected and may be shoveled out at the appropriate time into a bucket and the box cleaned by removing the end gate and letting the mud stream carry out the remaining cuttings. When these are washed away, the gate is replaced and the collection of the next sample is begun. By this means a representative por-

TABLE 1. Example of drilling-time form.

COMPANY_____ NO._____ FARM_____
LOCATION_____ COUNTY_____ STATE_____
WEIGHT ON DRILL PIPE_____ MUD WEIGHT_____ R.P.M._____ MUD VISCOSITY_____

DEPTH		DRILLING TIME		ACTUAL TIME	TIME OUT—REMARKS
FROM	TO	BEGAN	ENDED		

ACTUAL TIME IS TIME SPENT IN DRILLING. SHUT-DOWN TIME, ROUND TRIPS, CHANGING BIT, REPAIRS, ETC., ALSO CONDITION AND TYPE OF BIT SHOULD BE NOTED UNDER "REMARKS."

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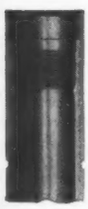

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AXELSON PIN-END PLUNGERS are designed to give improved service life of the chrome plating. Both ends of the plungers are externally threaded, thus eliminating the hazard of damaging the chrome plating as there are no internal threads to expand when the plunger fittings are tightened.

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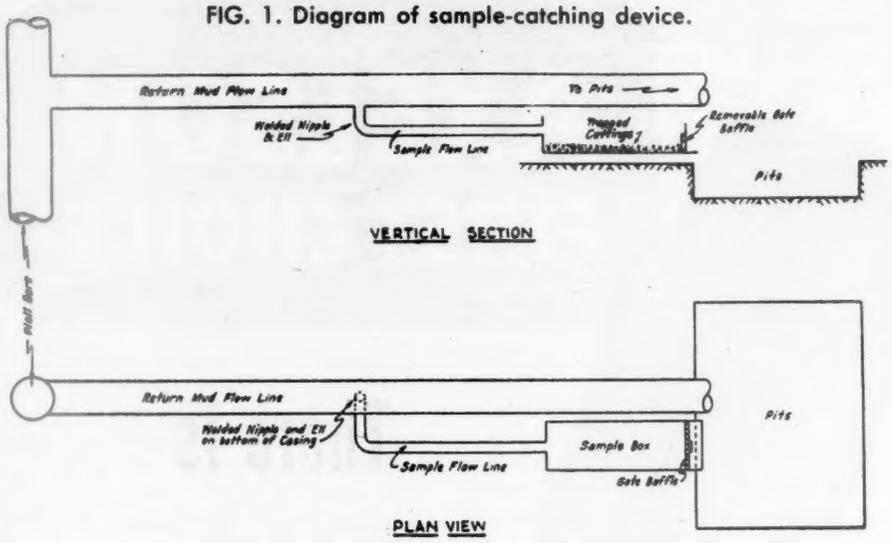
FIG. 1. Diagram of sample-catching device.



tion of both the fine and coarse parts of the cuttings is obtained. Sometimes such a box is set in the course of the main mud stream, but so many cuttings accumulate that the space behind the gate is filled with cuttings before drilling of the sample interval is completed so that the last part of the interval is not represented by the cuttings in the box.

After the samples are caught they must be washed properly. This can be done in a bucket by filling it partly full of water and stirring the samples vigorously, letting the clean part settle, decanting the fluid several times until the water is clear and sample is ready for sacking and labeling. Sometimes the sample is washed in a box with a fine-screen bottom. This hastens the washing process, but there is some danger of losing the fine sand from the sample. When drilling with oil or oil-base mud, the sample must be washed entirely free of drilling fluid before it is dried. This can be accomplished by using hot water, although some prefer to wash with kerosine or gasoline before washing with water. One need have no fear of washing the indigenous oil stain and saturation from the sample as any ordinary washing will only remove the drilling oil and will not remove the natural oil from the formation.

After washing, samples are commonly dried artificially. However, in samples showing stain and saturation this must be done with extreme caution as overheating will blacken the natural oil stain and mask the porosity as well as render it difficult to tell whether the formation fluid is oil, gas, or water. In extreme cases of overheating, red shales may be oxidized to a black color. If samples from wells drilled with oil-base drilling fluid are not washed clean before drying, it is impossible afterward to remove the drilling oil even by boiling the sample. In some cases where samples are to be used for paleontologic examination, any shale in the samples is digested with boiling water and soda to leave the fossils free. It is probably better when there is no necessity for haste in examination of the samples to let them dry naturally in the air rather than to dry them artificially.

After the samples are sacked and transported to the laboratory, it is commonly necessary to divide them into smaller portions for different types of examination or for examination by different individuals. This should not be done by merely pouring a little off the top of the sack as ordinarily there will be a few large cavings on the top of the sack. These should be raked off and discarded and the remainder of the sack mixed so every portion will be representative. All portions or "cuts" of the samples should be large enough to be representative. Generally a tablespoonful should be the minimum.

Examination of Cutting Samples

If the samples are properly prepared as outlined in the preceding section, they may be examined without further preparation. However, samples may not be washed properly on the rig and they must be rewashed before examination. This is most conveniently done in small saucepans. The samples are agitated in water and the fine mud decanted; this process is repeated until the water is clear. Machines have been invented to help in this operation, but they are economical only where large numbers of samples must be washed. Drying the samples should be done as slowly as possible so as not to overheat and burn the sample. If a sample is only slightly dusty it may be prepared for examination by shaking over a screen of 100 mesh or finer. Some samples contain cavings which are ordinarily larger than the cuttings. These can be scraped off the top after agitation, and the residue of the sample examined. The same process helps to remove gel flake and other plugging materials added to the mud to control lost circulation. Iron particles in the samples can be removed by a magnet.

Samples may be examined while covered with water. This method brings out by differential refraction some of the qualities of the sample such as oölitic structures and anhydrite crystals which may be overlooked in dry samples. When examining the sample wet, it is not necessary to have them so clean as when examining them dry since a certain amount of washing may be done in the water in which the sample is examined. Dry examination is more convenient since it is not necessary to have a number of petri trays or watch glasses with which to examine the samples in water.

Cuttings samples ordinarily are examined under a binocular microscope of low power. The exact power used varies with the individual geologist and with the nature of the samples. The power should be high enough to see the essential structure and texture of the cuttings. Porosity coarse enough to have a permeability sufficient to make commercial oil production should be seen easily. Oölites, inclusions, and other sedimentary features should be clearly visible also. On the other hand, the microscope power should be low enough to permit examination of large numbers of samples without eyestrain, and should permit a field of view large enough to estimate percentages of the various constituents accurately with only a few changes in position of the sample. The powers that meet these requirements vary between 12 and 24. Higher powers are used for special purposes such as the description of minor features of microscopic fossils. For general use, however, in the oil industry it is not desirable to have a power higher than 24 since a very high power may give false impressions about the permeability and porosity of cuttings.

The illumination of the microscope field is important. In the past small incandescent lights which may be focused to give intense illumination have been used widely. However, with the development of the fluorescent lighting tube, it has been found that the white light given by this tube is much superior to the yellowish light of the incandescent bulb. This is especially true when searching for oil stain in the cuttings, since the yellow-

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TABLE 2. Example of sample-description form.

OPERATOR_____ NO._____ LEASE_____ COUNTY_____

SECTION BLOCK LEAGUE SURVEY

LABOR_____ TWP._____ RANGE_____ FOOTAGE_____

ELEVATION_____ T.D._____ DATE_____ EXAMINED BY_____

DEPTH		LIME OR DOLOMITE	ANHY.				NON RED SHALE		RED SHALE	RED SS.	GRAY SS.		CHERT
FROM	TO		%	LITH.			%	LITH.					

ish incandescent light commonly masks the light brown oil stain. Usually it is not practicable to focus the fluorescent tube so as to give intense light for high-power work. However, for the usual low-power examination, the fluorescent tube is very satisfactory. In examining samples for oil stain and saturation it may be desirable to use an ultraviolet light.

In examining well cuttings samples the geologist should endeavor to estimate as closely as possible the proportion of each rock type in the sample and to describe the lithologic characteristics of the rock that are essential to the correlation of the beds. In commercial work it is not practicable to give the analytical detail that may be desirable in purely scientific research. The geologist, nevertheless, should endeavor to make the description as complete as possible in the time available. Necessarily, the description should be more detailed on wildcat wells than on field wells and much more detailed in the pay sections than in the upper sections. In field wells it is permissible to omit descriptions of long sections of comparatively insignificant beds between key beds. The geologist should remember that it is much better to have too full a description than too meager a description. Experience has shown that full descriptions have saved much time and money, whereas meager descriptions have resulted in redescription of the cuttings several times. Nevertheless, some redescription cannot be avoided, therefore, samples should be carefully preserved and indexed so that they will be available for future study.

There are two principal ways of describing samples. The first of these is the interpretative system, in which the geologist picks out the cuttings which he believes to be representative of the formation penetrated and describes the entire sample as composed of this rock. The rest of the sample is assumed to be cavings. This kind of description brings out formational changes and is of greatest value in areas where the various formations are of wide extent and relatively constant character, as in the Paleozoic of the Mid-Continent region. In areas of rapid lateral gradation in the lithologic character of formations, as in the Permian basin of West Texas, this method results in masking of lateral variations and misinterpretation of the nature of the stratigraphic column. This, of course, results in miscorrelation of the well logs.

In regions of pronounced lateral gradation it has been found that a second method of sample description is most satisfactory. This is the percentage description, where the geologist describes all material in the sample, disregarding obvious foreign substances and cavings. This system, though making it difficult to determine formational boundaries from the sample log, shows the gradations of the beds and often enables one to trace a horizon through different sedimentary facies.

Percentage of various constituents is estimated by the eye. It has been found that experienced sample examiners, using good samples, will agree very closely on the percentages of constituents. However, with poor samples where some judgment must be exercised in disregarding obvious cavings, the value of the description is dependent on the judgment of the geologist who examines the samples. Mechanical counters or calculators, such as the integrating stage, have not been found to give enough additional accuracy to be worth while in ordinary work. Experienced sample examiners can describe 100-300 samples in an 8-hr day, according to the nature of the cuttings.[1]

The descriptions may be written out or plotted directly on a log strip. For many purposes, it is desirable to make written descriptions, since the logs can be plotted in several places at the same time and a record is kept which is not subject to destructive wear as is the plotted log which is used constantly in the field and laboratory. A type of description form is included (Table 2). In addition to the constituents shown on this form, others may be specified according to the nature of stratigraphic sections in the area worked. Pyrite and differently colored shales will be the most likely additions. In areas where sand production is important, separate columns for porosity and saturation in sandstone may be desirable.

Color of the rock fragments in cuttings samples is a very important attribute. At present there is a wide variation in the descriptions of color by subsurface geologists. The same rock may be described as tan by one and brown or gray by another. It is desirable in any organization attempting to start sample examination work to standardize some color scheme, possibly that being developed by the inter-society committee.[2]

Size of particles in dolomites and limestones is another matter on which subsurface geologists vary. The following table gives tentative scale of crystal sizes which was developed by the West Texas Geological Society several years ago. It would be to the advantage of anyone undertaking sample description for the first time to adopt a scale with appropriate abbreviations for the sample-description sheets.[3]

Porosity, Permeability, and Oil Stain

Description of the porosity, permeability, and oil stain of cuttings samples is one of the most important parts of the sample examiner's work. In sandstone, the porosity is determined by the size of the grain, the sorting, and the amount of the cement present. The grain size should be described by some standard scale such as Wentworth's[4] or Alling's.[5] The sorting is dependent on the proportion of fine minerals present, such as silt or shale, or the proportion of large grains, such as large frosted quartz

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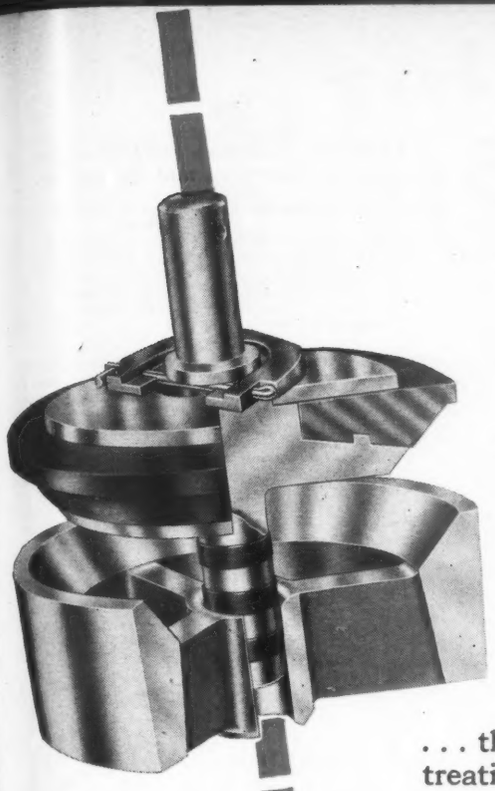

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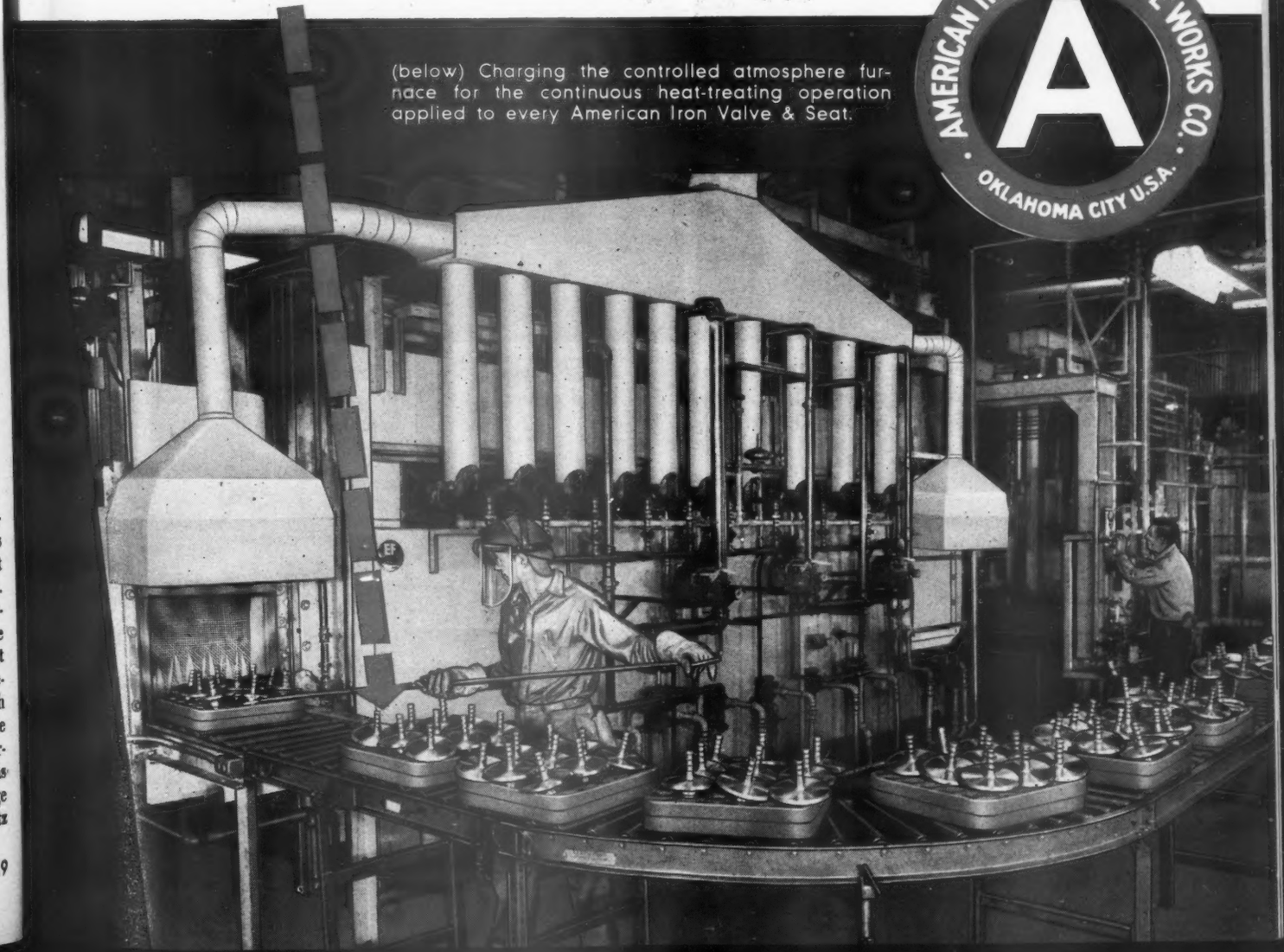

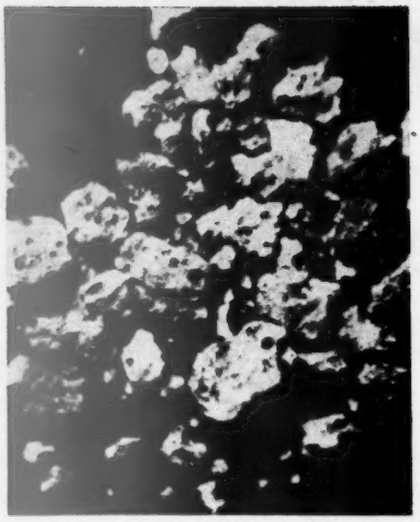

FIG. 2. Very good leached oölitic porosity in dolomite. 5×. Champlin's 1-D. 8030-8060 ft. Sec. 26, Blk. 13, University Lands.

grains commonly found in the Whitehorse section of the Permian basin. The amount of cement also largely determines the porosity which is at a maximum in free unconsolidated sands and minimum in quartzite. The permeability is largely determined in the same manner as porosity, but here the size of grain and the sorting are most important.

Oil stain and odor are very important and much experience on the part of the sample examiner is required to estimate these accurately. Dry gas will not stain sandstone, but wet gas may show a very light tan stain. Oil is commonly darker, but very high-gravity oil shows no more

TABLE 3. Tentative scale of crystal sizes in dolomites and limestones.

Descriptive Adjectives	*Crystal Diameter*
1. Mat	Invisible
2. Microcrystalline	Less than 10 mm.
a. Cryptocrystalline	Less than 0.02 mm.
b. Finely crystalline	0.02 to 0.1 mm.
c. Mediocrystalline	0.1 to 2.0 mm.
d. Coarsely crystalline	2.0 to 10 mm.
3. Megacrystalline	

DEFINITIONS

Mat.—Compact, exceptionally homogeneous; having a dull but even surface under low-power binocular microscope; resembling limestones used in lithography; as, a *mat* limestone, a *mat* dolomite.

Microcrystalline.—Having crystals less than 10 mm. long; having crystals small enough to be viewed under low-power binocular microscope.

Cryptocrystalline.—Indistinctly crystalline; showing very small, indistinct crystal faces; composed of crystals too small to be measured under low-power binocular microscope.

Megacrystalline.—Having crystals 10 mm. or more in length; having crystals too large to be readily discernible under low-power binocular microscope.

ALL DOLOMITE SAMPLES FROM ANDREWS COUNTY, TEXAS

FIG. 3. Granular dolomite with good intermediate type porosity. Reverse circulated cuttings. 10×. Penrose's University 2. 4465-4470 ft. Sec. 3, Blk. 10.

FIG. 5. Isolated pin-point porosity in dolomite. Reverse circulated cuttings. 5×. Penrose's University 2. 4410-4415 ft. Sec. 3, Blk. 10.

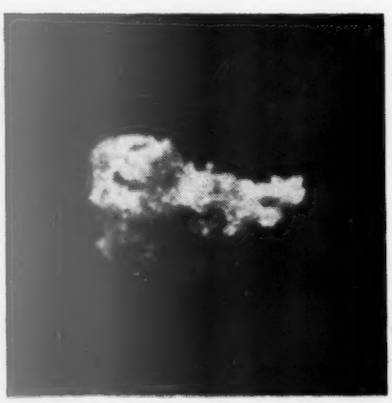

FIG. 4. Left, porous dolomite, apparently part of lining of fissure or vug. Note covering of free dolomite crystals. 5×. Penrose's University 2. 4460-4465 ft. Sec. 3, Blk. 10.

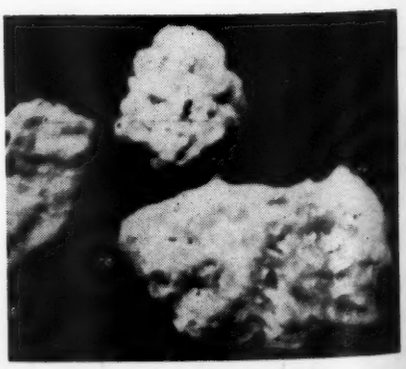

FIG. 6. Right, cavernous type porosity in dolomite. 5×. Fuhrman's Boner B-9. 4365-4400 ft. Sec. 25, Blk. A-43.

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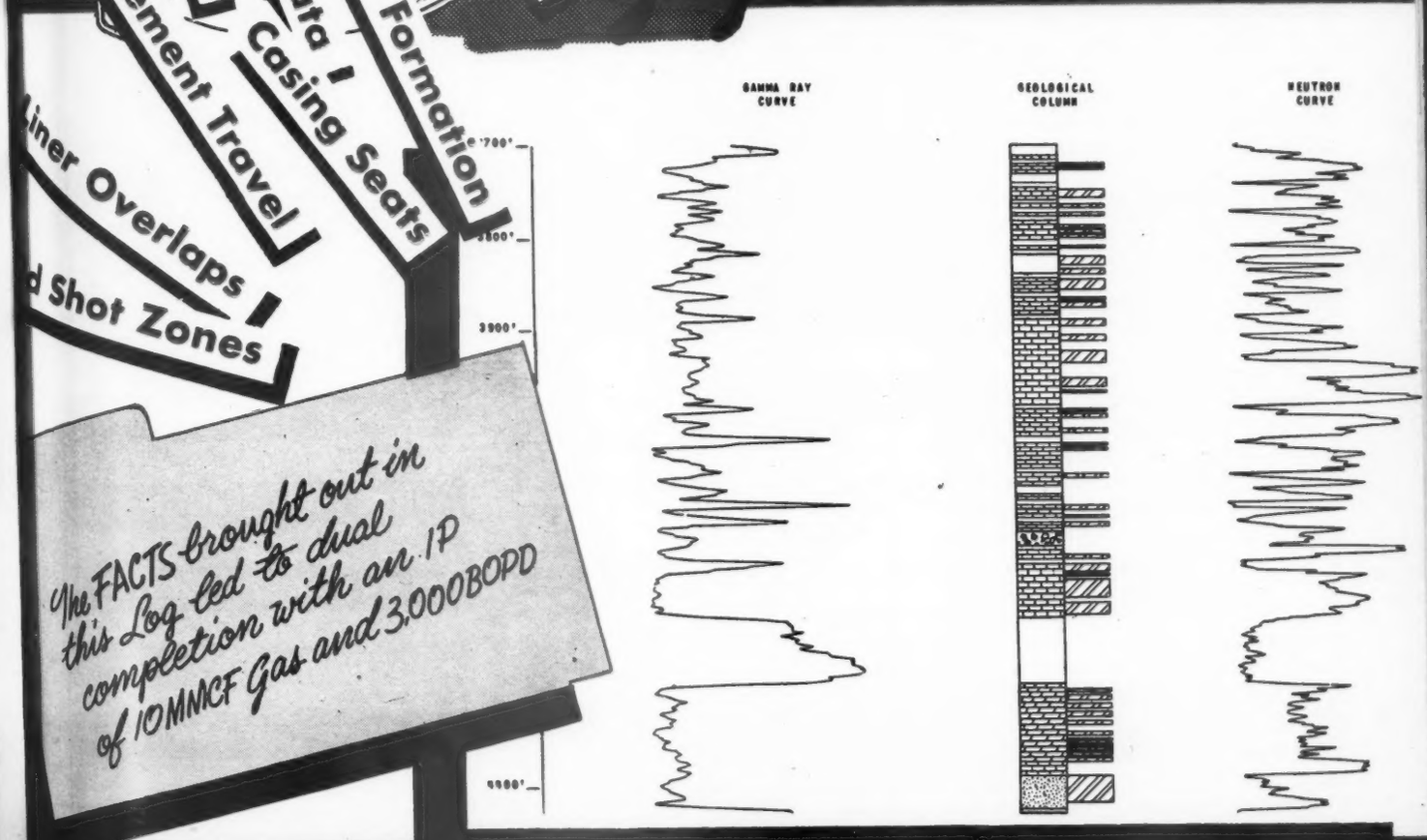
GAMMA RAY CURVE
GEOLOGICAL COLUMN
NEUTRON CURVE
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3800'
3900'
4000'
The FACTS brought out in this Log led to dual completion with an IP of 10 MMCF Gas and 3,000 BOPD

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stain than the gas. Porous sand, containing no stain whatsoever may be suspected of carrying water. In examining samples of oil stain, it is very convenient to have a fluoroscope. This may detect very light stains of high-gravity oil which are not obvious in ordinary light. Best results in detection of oil stains are obtained with mercury vapor lamps emitting light, with wave lengths ranging from 3300-3800 Angstrom units. Lamps giving light of shorter wave lengths, such as the quartz tube, cause fluorescence of oil, but also cause much mineral fluorescence in the sample which may confuse the observer.

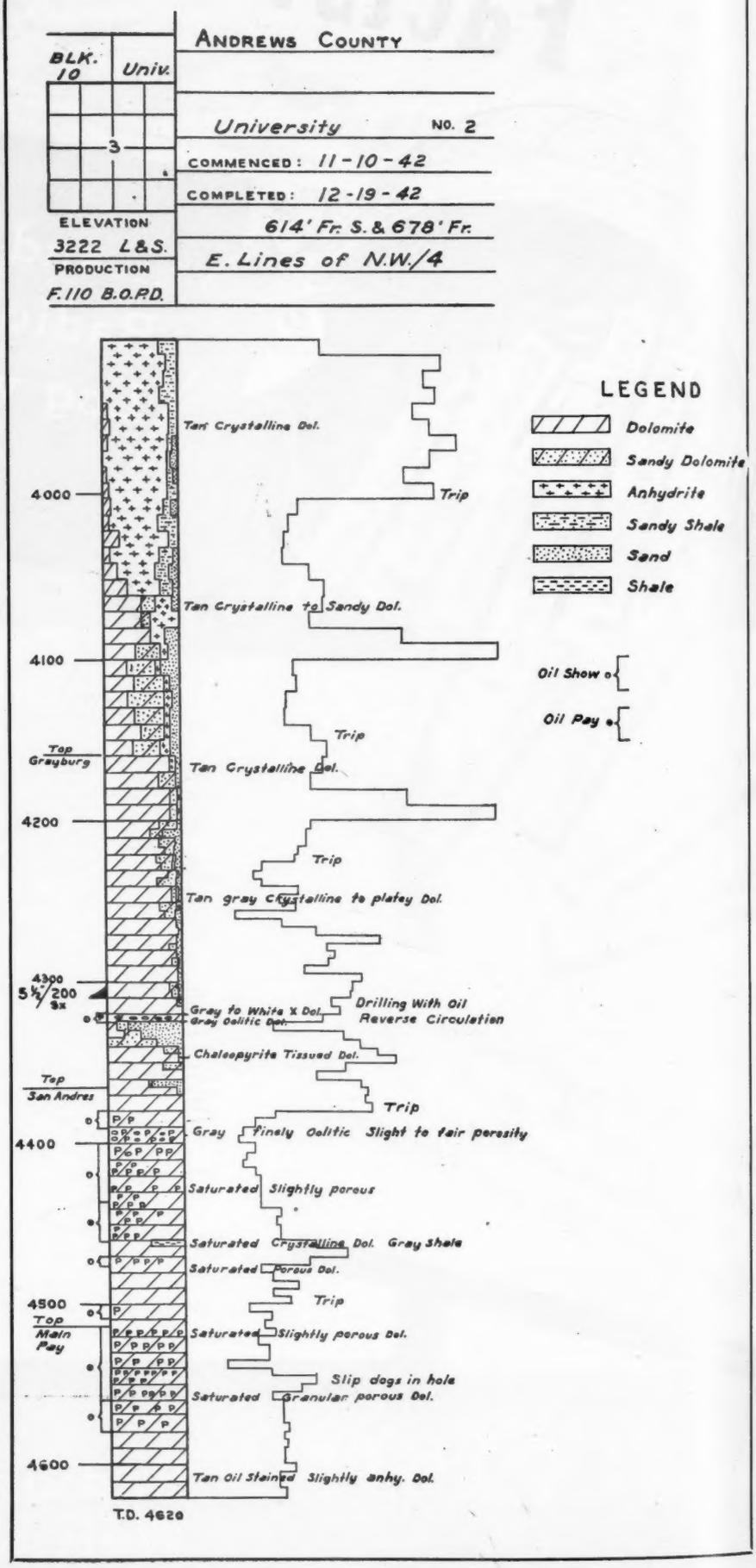
Use of Cuttings Descriptions in Study of Limestone Reservoirs

Limestones and dolomites form important oil reservoirs, and cuttings descriptions furnish one of the chief sources of information concerning them. There are two chief types of porosity in these rocks. The first is intergranular porosity which consists of openings between the crystals, oölites, or other discrete particles of the rock which in its geometry is similar to sandstone porosity. The second is fracture porosity (or foramenular porosity of Bulnes and Fitting[6]) which consists of large openings through otherwise solid masses, such as fractures and vugs.

The intergranular porosity is easily observed under the binocular microscope where the tiny openings may commonly be seen connected with each other. The larger openings are not ordinarily visible in their entirety under the microscope but are indicated by irregular surfaces lined by crystals which have been formed in a comparatively large cavity. These large openings are much more difficult to detect than the smaller pores and ordinarily they have gone unnoticed unless indicated by the drilling-time or the manner of drilling. Permeability in the fractures or foramenular porosity is almost impossible to determine under the microscope since there is no means of knowing how far apart the walls of the large openings originally were.

Permeability in intergranular porosity can be estimated qualitatively by noticing the sizes of the pores and their apparent interconnection. In general, the larger the pores the higher the permeability. The converse, however, is not always true. Some dolomites showing very fine porosity are shown by core analysis to be surprisingly permeable. However, one type of porosity is non-permeable almost without exception. This is called pin-

FIG. 7. Type sample log of producing section.



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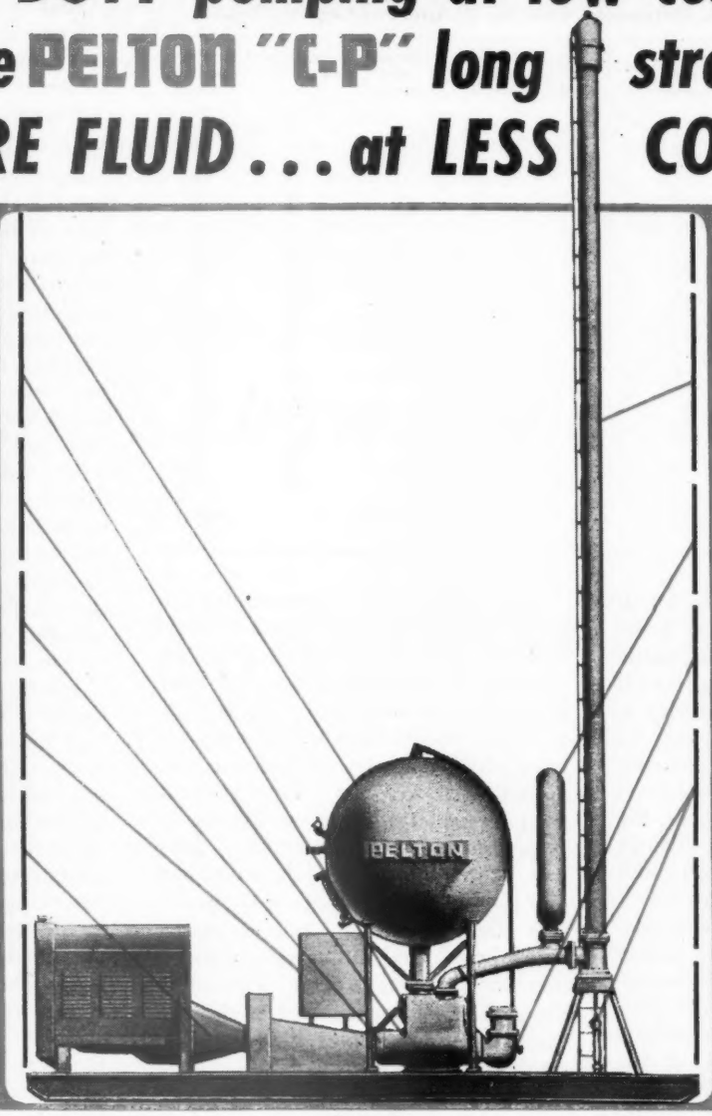

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TABLE 4.

Detailed recovery estimate, University Well No. 2, Andrews County, Texas

Depth in feet	Remarks	Net feet slight porosity	Net feet fair porosity	Net feet medium porosity	Net feet good porosity	Acre-foot recovery	Recovery per acre (barrels)
4380–85	Stained	1				75	75
90	Stained	1				75	75
4400–05	Sat. v. sl. por.	2				50	100
10	Sat. oolitic	3				100	300
15	Sat. isolated por.	3				50	150
20	Sat. gran. v. Sl. por.	4				50	200
25–30	Sat. v. sl. por.	4				50	200
35	Sat. v. sl. por.	1				50	50
40	Sat. v. sl. por	2				50	100
45–50	Sat. sl. por	1				100	100
55–60	Sat. gran.	2				125	250
65–75	Sat.	4				150	300
4500–05	Stained	1				75	75
10	Sat.	1				100	100
15–20	Sat.	5				75	375
25	Sat.	5				75	375
30	Sat. gran.	5				100	500
35	Sat. gran.	3				100	300
40	V. sl. f. por.	5				40	200
45	Sat. gran.	5				100	500
50	Sat. cryst. sl. gran	3				50	150
55	Sat. cryst.	1	2			200	600
60	Sat. gran.	4				150	600
65	Sat. gran.	1	1			200	200
		65	3		Total.....		5875

point porosity and consists of small isolated holes. Some of these holes contain small amounts of asphaltic material and even may contain live oil and gas, but commercial production is not developed from them. So far, no quantitative results about porosity and permeability have been obtained from ordinary cuttings. However, the coarser reverse circulation cuttings have been analyzed for porosity and permeability with favorable results.

An interesting method of reproducing and visualizing these pore spaces is presented by Nuss and Whitney,[7] who impregnated limestones with plastic and then dissolved the limestone with acid, leaving a model of the porosity as a residue.

Oil and gas stains are ordinarily readily detectable in limestones and dolomites. The heavy sour oils, as found in the Upper Permian, leave a dark brown stain which is unmistakable. Lighter oils of the Lower Permian rocks show good stains while the very light oils found in the Lower Paleozoic strata leave an extremely light stain which is difficult to detect under incandescent light, but may be seen in white or ultra-violet light. Since most gases carry a small amount of light oil with them they will show slight stains in limestones. Gas-oil contacts commonly can be recognized accurately by the darkening of the stain at the top of the oil column. Water may be indicated by lightening of the stain and black asphaltic residues in the samples. Many dolomites have a characteristic sheen on crystal faces within the water zone. However, a well oil-stained section may produce water upon test. This may be attributed to later movement of the structure which causes shifting of the water table.

In concluding the discussion of cuttings description, it should be said that no rigid rules can be given for guidance in describing samples. Each geological province and each geological organization have their own problems which must be worked out individually. Since the stratigraphic sections penetrated by wells are as varied as those on the surface, there can be no substitute for experience and judgment on the part of the geologist. Description of samples should never be allowed to degenerate into a mere mechanical process. The better the geological background of the person examining samples, the better will be the description.

Plotting

After the description of the samples is made, it must be plotted in graphic form to make the information easily available for correlation and study. It is usual to plot this material on a narrow strip of heavy paper or cardboard so that a large number of logs can be laid out to compare and correlate the sections. A 3-in. width has been found to be most convenient for this purpose. Upon this 3-in. strip the lithologic characteristics are plotted on a column ½-¾ in. wide with a vertical scale of one inch equals 100 ft. On this column each 10 ft (1/10-in.) is marked so as to facilitate plotting. The rest of the log strip is used for notes on lithologic characteristics that are not easily plotted as symbols. It has been found in plotting the lithologic characteristics that strong contrasting colors facilitate correlation and comparison of the sections. While no standard system of symbols has been adopted, the following colors are widely used.

Light blue = Calcareous limestone
Dark blue = Dolomite
Red = Red shale
Gray = Gray shale
Yellow = Sandstone
Green = Salt
Purple = Anhydrite

Other colors may be added for local necessities. It has been found very helpful also to plot the drilling time next to the lithologic column on the log strip. In the case of mechanically taken drilling time, a copy of the graph is plotted; with manually taken drilling time, the plotting is done as bar graphs—the common scale being one inch equals 100 min of drilling time.

Porosity and oil stain in the samples are indicated by symbols on either side of the lithologic column. These symbols may be either in ink or in suitable colors. It is very helpfull to make some distinction as to probable gas or water stain even though these fluids cannot be differentiated certainly from cutting examination. Sharp changes in lithologic character should be indicated plainly on the plotted log. This usually is done best by having the geologist who examined the samples check the plotted log and indicate where he believes the formation boundaries should be, because their exact position is commonly difficult to determine from the written description alone.

All tests and showings should be indicated on the margin of the log strip. These should include all drill-stem tests in rotary wells, and amount and kind of fluid in cable-tool holes. It is also helpful to indicate any swabbing tests taken, the acid used, amount of nitroglycerine used and section shot, and perforations in the casing. Casing seats should be indicated on the margin of the log with a notation of the diameter of the casing and the amount of cement used in setting the casing. Total depth, location, and initial production of the well should be shown in the heading of the log strip.

Using Sample Logs

The first use of these sample logs is stratigraphic correlation, by laying the logs alongside each other and matching bed for bed as far as possible. In doing this the geologist must keep in mind probable lateral gradation, probable contamination of samples, and probable changes in intervals from one horizon to another. Care should be taken not to correlate over any greater distance than is necessary. For correlation purposes one tries to select wells close together and extending as far as possible along the lithologic strike. This information can be used for construction of cross sec-

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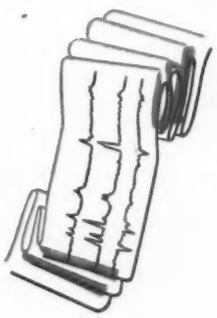

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tions[8] and stereograms[9] to show stratigraphy.

After these correlations are made and the stratigraphic section established, zones can be found whose tops will make good index beds for structural mapping. In selecting such horizons one must consider that the depths of samples from which the logs were made may not have been corrected for the lag in coming to the surface. Therefore, especially in zones far below the surface, the geologist must allow for this correction or must correct his datum points by the drilling time if available.

Another important use of sample logs and descriptions is in the analysis and evaluation of any pay zone, especially in limestone reservoirs. This may be done by tabulating the pay sections in columns, as show in Table 4. The first column shows the depth of each sample in the pay section, the second column shows the net feet of pay which is the percentage of porosity and saturated material in the sample times the sample interval, and the next columns give the quality of the pay which is the geologist's estimate of the porosity and permeability in a qualitative manner, such as slight, fair, medium, and good. The next column shows the probable acre-foot recovery from the pay. This figure is derived from core analyses in this field if available or from sample descriptions of pay in fields where the ultimate recovery is reasonably well established from past production. The next column in the analysis is the recovery per acre, which is the acre-foot recovery times the net feet of pay. This gives the recovery per acre for each sample interval. The total of this column gives the recovery per acre for the well. Of course, this is a volumetric estimate of the recoverable oil from any well, and since limestone reservoirs are commonly heterogeneous in their composition, this recovery estimate falls within wide limits of error. Well spacing, of course, has a considerable effect on ultimate recovery. Thus, if the acre-foot recovery figures are derived from wells differing in spacing from the well under analysis, due allowance must be made for this difference in spacing. Generally, it is found that this volumetric estimation is somewhat above an estimate made from pressure decline or production decline curves, and allowances should be made. In spite of its imperfections, this method of valuation is the only one available in many fields in which cuttings samples have been kept but no other type of reservoir information is available.

A somewhat similar method may be used in the case of sandstone reservoirs. However, since sandstone reservoirs are much more uniform in their porosity and permeability it is commonly possible to assign an acre-foot recovery for an entire field and to obtain the ultimate recovery by multiplication of the net pay sand thickness in any well by the acre-foot recovery, rendering detailed pay analysis unnecessary.

Logs of cuttings samples are also very useful in studying the characteristics of limestone reservoirs. They give some idea of volume and relative permeability of lenticular pay zones. They are a useful supplement to any coring program undertaken as part of a reservoir study. It is often possible to select gas-oil contacts from cutting logs so as to select points for plug-back or for packer settings in remedial work.

Summary

Samples of well cuttings can be taken from both cable-tool and rotary holes in such a manner that the nature of the formations penetrated can be determined accurately. These samples can be described by a geologist and the description plotted so as to give a graphic section of the formations encountered in the well. These sections can be correlated to give a picture of the regional stratigraphy. From the sections, index beds can be selected for use in structural contouring.

From the sample descriptions, volumetric estimates of ultimate well yield can be made, reservoir study facilitated, and well remedial work guided.

* * *

Bibliography

1. A full description of sample examination as applied to stratigraphic work is given by L. H. Lukert, *Oil and Gas Journal* (June 17, 1937), pp. 49-51.
2. Ronald K. DeFord, "Rock Color Chart for Field Geologists," *Bulletin American Association Petroleum Geologists*, Vol. 31, No. 10 (October, 1947), pp. 1903-04.
3. A more elaborate scale is advocated by Ronald K. DeFord, "Grain Size in Carbonate Rocks," *Bulletin American Association Petroleum Geologists*, Vol. 30, No. 10 (November, 1946), pp. 1921-28.
4. C. K. Wentworth, "A Scale of Grade and Class Terms for Clastic Sediments," *Journal Geology*, Vol 30 (1922), pp. 377-92.
5. H. L. Alling, "A Metric Grade-Scale for Sedimentary Rocks," *Journal Geology*, Vol. 51 (1943), pp. 259-69.
6. A. C. Bulnes, and R. U. Fitting, Jr., "An Introductory Discussion of Reservoir Performance of Limestone Formations," *Petroleum Development and Technology, 1945, Petroleum Division, Trans. Amer. Inst. Min Met. Eng.* Vol. 160, pp. 181-201.
7. W. F. Nuss, and R. L. Whitney, "Technique for Reproducing Rock Pore Space," *Bulletin American Association Petroleum Geologists*, Vol. 31, No. 11 (November, 1947), pp. 2044-49.
8. John M. Hills, "Rhythm of Permian Seas," *Bulletin American Association Petroleum Geologists*, Vol. 26, No. 2 (February, 1942), pp. 217-55.
9. Frank E. Lewis, "Position of San Andres Group, West Texas and New Mexico," *ibid.*, Vol. 25, No. 1 (January, 1941), pp. 73, footnote 1.

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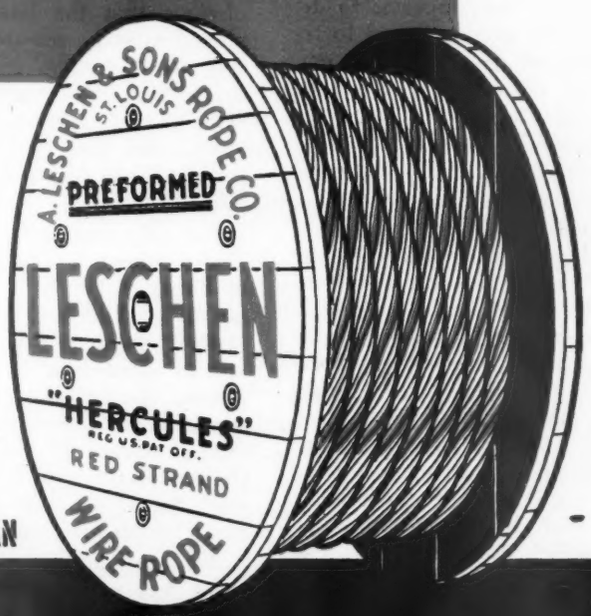

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Construction of Offshore Drilling Platforms With Large Diameter Pipe Piling*

M. P. ANDERSON†

THE driving of large diameter pipe piling in the open waters of the Gulf of Mexico is a problem that was once viewed with considerable misgiving on the part of engineers and construction men. Especially so when the spacing and alignment of these piles must fall within a tolerance to permit the erection of prefabricated steel trusses or other structural members.

The company with which I am associated has been successfully engaged, however, in operations of this nature for about two years on locations off the Texas and Louisiana coast line. The piling driven in this work formed the foundation or substructure of drilling platforms constructed for various oil companies.

The intent of this paper is to describe the equipment used and to relate the methods and procedure employed in the construction of one of these particular structures. In addition, comment is offered regarding Gulf platform construction in general based on our experience to date.

Description of Platform

The platform under discussion was constructed during the hurricane season of 1948. It is located about 11 miles offshore in the Louisiana Cameron area, about midway between Sabine and Calcasieu pass. At this point the depth of water is 33 ft.

Designed to withstand hurricane winds and the impact of storm waves, the platform stands 28 ft above mean Gulf level. Plan dimensions are 80 ft by 193 ft, which provide space for a 136-ft derick, pipe rack, numerous tanks, the rotary, drawworks, mud pumps, diesel engines, quarters building, and so on, a total live load in excess of 5,000,000 lb. The reactions from this mass of paraphernalia are transmitted through a system of floor beams and double Warren type trusses to a total of 36 piles. Pile spacing is on 30-ft centers, generally, although 15-ft spacing is necessary in some areas of weight concentration. Pipe piles are 30-in. in diam with a wall thickness of 5/8 in. The maximum length is 130 ft. A penetration of about 75 ft below Gulf bottom provide adequate bearing for the maximum loading of 200 tons per pile. This structure is braced both transversely and longitudinally by a system of heavy wire ropes attached to the piles. These cables extend diagonally from a point below the mud line upward to connect to the pile caps just under the trusses. Turnbuckles provide the means of tightening these braces.

Selection of Construction Equipment

Before embarking on a construction venture of this nature it is needless to say that one must be suitably equipped for the task at hand. It is obvious that the floating craft employed must be seaworthy. The work boat or barge for carrying the pile driver and crane must have sufficient stability to permit operations in small waves and also be able to weather sudden blows of considerable magnitude.

For this service the company was able to secure a surplus Navy lighter or barge of the YF class. This craft has an overall length of 260 ft, a beam of 48 ft, and measures some 15 ft from keel to main deck. It is not self-propelled. The bow is raised and has a conventional nosed shape while the stern is square. It is ideal for towing. Quite a number of these vessels were used during the late war as general cargo barges for ocean service.

As originally constructed cargo space was provided above the main deck in a house extending the full length of the ship as well as below main deck. Crew quarters were forward in the bow. In converting the vessel for its new service most of the deck house was removed to provide space for construction equipment and open storage leaving just enough of the house for berthing and feeding some 50-odd men, ten of whom comprise the normal ships crew.

Piles are driven off the stern. Full length conventional leads for handling these long piles were considered to be impracticable due to the length and magnitude of such a structure, its wind resistance, and the overall effect on the stability of the barge. Such a tower might even wreck itself in a rough sea. Compromise was made on an open top lead 60 ft high supported by a tower of like height. Hinged collar clamps located top and bottom on the lead hold the pile in place at the start of driving. The leads are hinged to provide adjustment laterally while the tower is hinged to provide adjustment in alignment fore and aft; this to compensate for listing of barge.

The revolving crane for handling piles, hammer, and for general service is located just behind the lead tower. This crane, mounted on a self-propelled gantry, is equipped with a 120-ft boom and has a lifting capacity of some 50 tons. The gantry clears the deck by 7 ft leaving storage space beneath for piling. The wheel trucks were removed from this gantry, and, in lieu thereof, a special arrangement of rollers was constructed to provide a 50 ft movement along the deck. This alteration made a less cumbersome arrangement and is considered more stable than truck mounting. Provision is made for lashing the crane to the deck and for securing the boom horizontally in a U-shaped rest; a must for heavy seas. Some of you may remember the old sea story about the small cannon that tore loose on the deck of a frigate and became a terrible instrument of death and destruction.

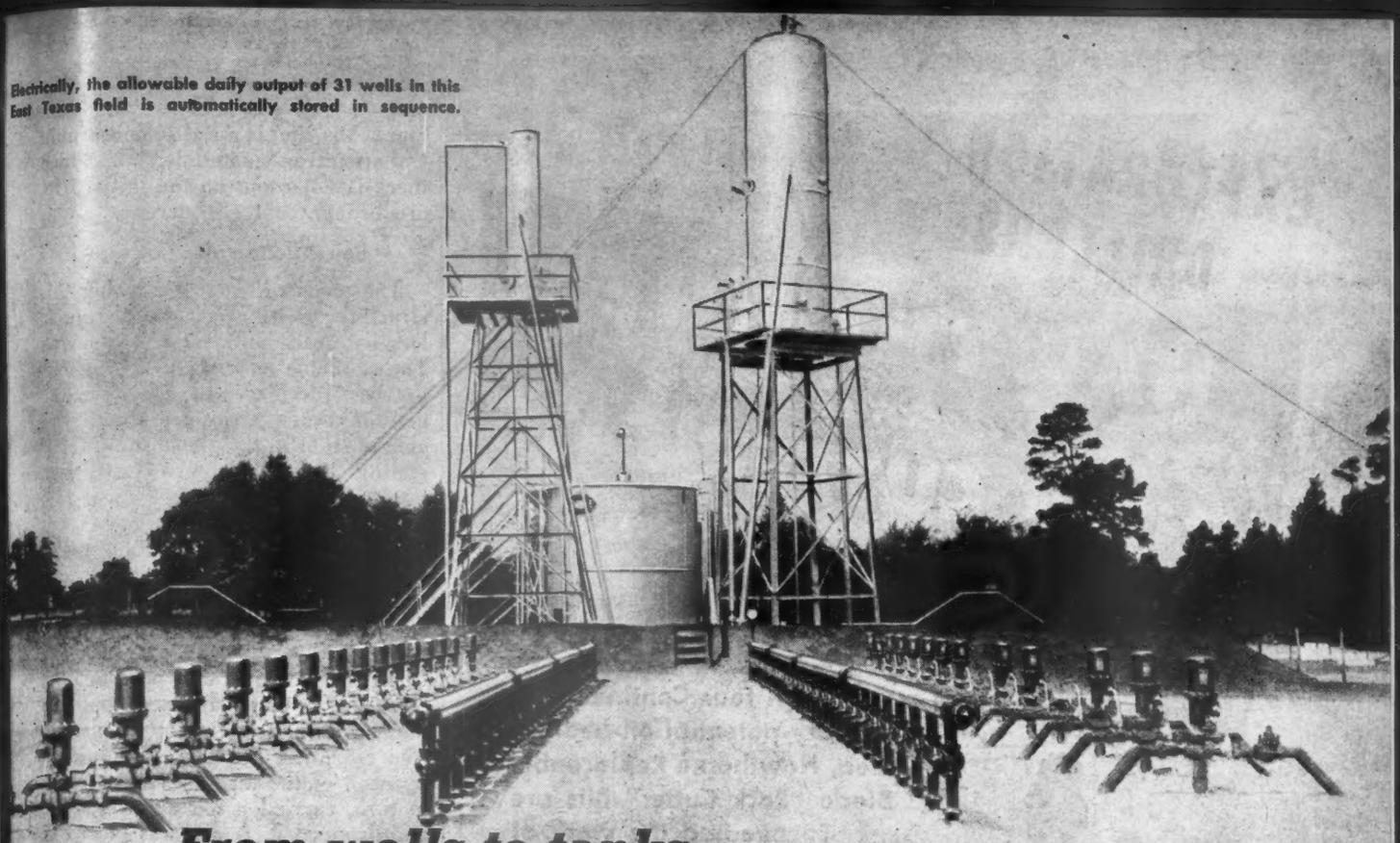
Located below deck are the 125-hp boilers for supplying steam to the hammer and winches, the 400-kw a-c generator that supplies power for the crane, and the two d-c generator units that supply power for lighting, cooking, refrigeration, pumps and so on. The latter was part of the ship's original machinery.

Now about anchors, a very important feature. The ship's original bow anchor and winch are used without alteration. In addition, four 5000-lb anchors with the necessary steam hoists were installed for maneuvering at the site of the work. The wire rope lines for these anchors are arranged to fan out at angles of 45 deg, two at the bow and two at the stern.

This construction boat, once loaded

*Paper presented at the ASCE Spring Meeting in Oklahoma City, Oklahoma.

†Associate Member, American Society of Civil Engineers, and Chief Engineer, Brown & Root, Inc., Houston, Texas.



Electrically, the allowable daily output of 31 wells in this East Texas field is automatically stored in sequence.

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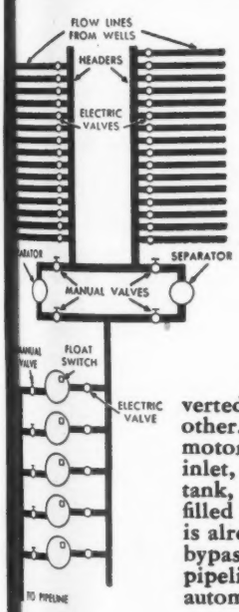

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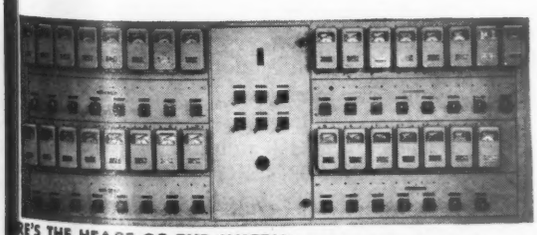

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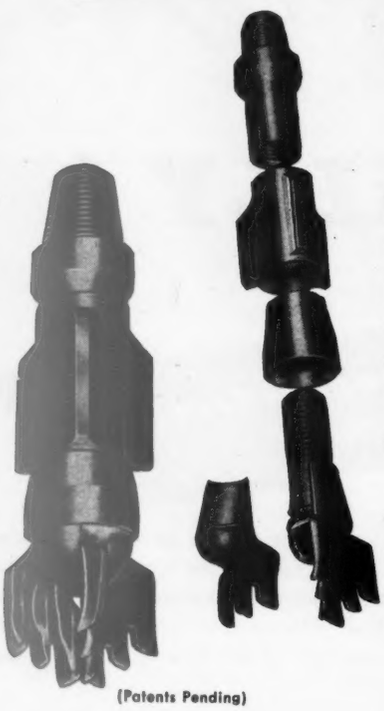

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See GEOPHYSICAL DIRECTORY or COMPOSITE CATALOG for lists, parts, prices —or write for illustrated Catalog. Hawthorne Bits are available in a range of sizes to fit any drill.

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and at the site, is a self-sufficient unit. Construction materials, for which there is not room on the initial trip, are brought out on barges.

Construction of Platform

The mechanics of positioning this structure in its exact predetermined location in the Gulf warrant comment. The probable location of the oil having been decided with the usual degree of accuracy, engineers were then able to sight in the platform by intersecting lines from two instrument towers located on shore. Direct radio communication between these transit stations and the construction barge was used to guide the vessel to position.

Pile Driving

Having attained this position, the bow anchor was dropped and the barge allowed to swing into the wind. The attending tug boat then picked up each of the maneuvering anchors in turn, carried it out about 1000 ft and dropped it. A pile was placed in the leads and used as a sighting mast for the transit stations. This first pile was a certain designated one, usually at a corner, and when driven served as a reference point for the location of the remaining piles. When the position of this pile was "okayed" by radio it was lowered and allowed to sink of its own weight into the floor of the Gulf. Driving followed.

The crane boom is of sufficient length to place the hammer on top of a pile extending about 100 ft above the water. This distance plus the depth of the water plus the depth the pile will penetrate the floor of the Gulf due to its own weight determine the maximum length that may be handled. At locations requiring lengths of piling in excess of this limitation it is necessary, of course, to splice piles during driving. This joint is made by means of a welding sleeve or collar. Such a field splice requires about 3 hr time for a 30-in. pile.

On this particular job, with the pile free on the bottom, the top of the pile extended some 30 ft above the top of the leads. The hammer, merely suspended from the crane boom, is placed on top of the pile and driving starts. Later, the hammer enters the leads, the collar clamps around the pile are swung clear, and the hard driving at the end done in the conventional manner.

The hammer used on this job was a Vulcan, size OR, weighing 9 tons. The ram weighs 9300 lb and has a striking energy of 30,225 ft lb. A special helmet, placed between hammer and pile, is used for driving these 30-in. pipes. This helment consists of a 3-in. steel

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here's how I sink those deep producers

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"But, it isn't a matter of luck. It's simply that I insist on doing the whole job with NATIONAL Seamless.

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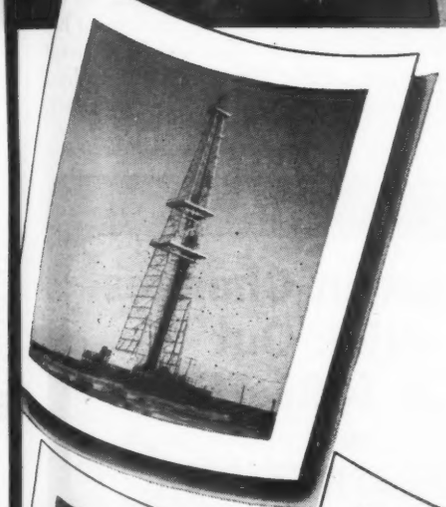

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NATIONAL SEAMLESS

drill pipe . . . casing . . . tubing

UNITED STATES STEEL

plate about 3 ft square that is positioned on the pile by means of a loose fitting bull nose. A steel ring on top of this plate holds the hardwood block, which receives the blow of the hammer. Thus the striking energy is distributed over the full periphery of the pipe.

These pipes are driven with open ends. Resistance to driving at the beginning results from skin friction on both the outside and the inside of the pipe. Later, as skin friction within the pile increases, some displacement and consolidation must occur in the soil below the tip of the pile as well as consolidation within the pipe itself. It is noticed in some cases that the ground level inside the pipe was lowered as much as 10 ft. This lowering is advantageous if the structure is to be removed and it is desired to break the piles by blasting. In this case the explosive charge may be placed inside the pipe below the floor of the Gulf without any prior removal of material from within the pipe. The portion of the pile remaining after shooting is below the mud line and presents no hazard to navigation.

Our experience regarding penetration in various locations may be generalized by stating that off the Texas coast and the adjoining Louisiana area, satisfactory bearing and sometimes refusal may be reached by penetrations of 40 to 90 ft while to the east and increasing towards the Mississippi delta penetrations of 150 ft upwards may be necessary. It is believed possible that off Galveston refusal might be experienced before desired penetration because of the fact that one test pile was driven to refusal with only 38 ft of penetration. Then there is always the possibility of a location falling on a thick shell reef. The question of penetration can only be answered by driving a test pile at the specific location.

Cable Bracing

I mentioned previously that the structure is braced under water with wire rope diagonals. These are 1½-in. diam, 6 x 19 galvanized prestressed bridge ropes. Prestressing to just under the elastic limit is done by the cable manufacturer and serves to remove a large portion of the structural stretch that would otherwise have to be taken out upon installation. Turnbuckles are provided at the upper connection for adjusting the tension. Molten zinc connection between sockets and wire rope were used throughout.

Quite obviously the simplest method of effecting an underwater connection between pile and wire rope is to fasten wire rope to pile before driving. This lower connection between cable and pile is made by means of wire rope sockets pin-connected to a collar plate around the pile. This collar plate is fixed vertically but free to rotate in case the pile revolves during driving. This is probably an unnecessary refinement because experience to date indicates no such rotation. Some collars have as many as four cable connections. Cable sockets are actually pinned to the collar lugs, when during driving, the collar has cleared the bottom of the leads. No difficulty is experienced in handling the cables as the pile is driven to final depth.

Now, how do you know just where to attach the collar to the pile prior to driving? Considerable care and judgment need to be exercised in this connection. The required penetration is known in advance from the test pile data as well as the nature of the material immediately below the Gulf bottom. The ideal point is below the mud line where the ground is firm enough to furnish side bearing on the pile to resist horizontal movement but not to a depth that would prevent bringing cable out on a straight line.

On one location it was necessary,

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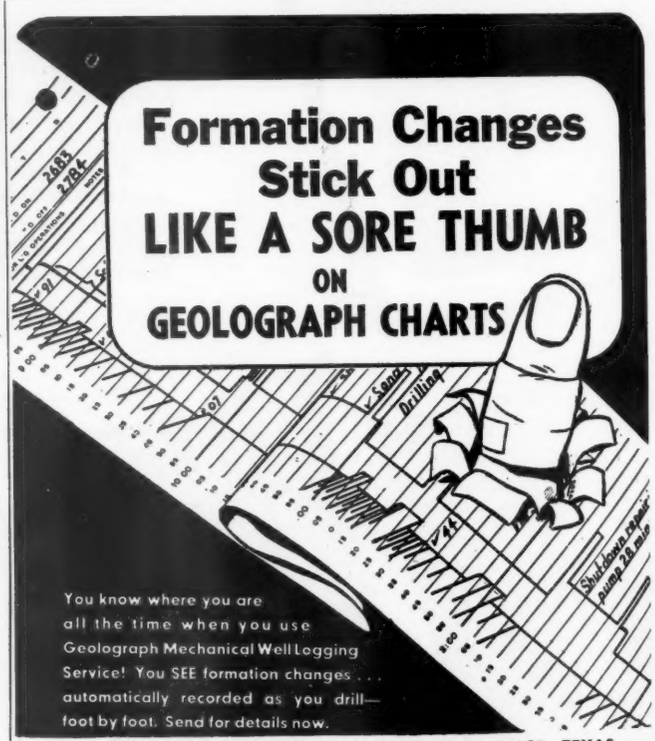

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due to bad weather, to leave such a pile partly driven. Upon resuming operations later the pile was found to be "frozen" and would not start, thus leaving the cable connection many feet above the desired point. In this case a new split collar was placed around the pile at the mud line and welded thereto; this being done by divers and underwater welding.

Steel Setting

After piling are driven they must be brought into exact alignment relative to one another. This is done by timber struts arranged in pairs to clamp the piles. Circular cuts in the timbers at the proper place assist in this operation. It is not difficult to move the tops of these piles the 2 or 3 in. sometimes necessary to bring them into exact position. The timber struts also serve as scaffold support for the subsequent work of cutting and capping piles, welding trusses to caps and making up the top connection of the cable bracing.

Transverse trusses were prefabricated in full 75-ft lengths while the intermediate longitudinal trusses came in 30-ft lengths. Trusses are welded to the pile caps and to each other at the points of intersection. A portal brace is achieved where trusses fasten to outside piles by having these particular piles extend upward so that both top and bottom chords are welded thereto. Interior piles are cut off lower and merely support the bearing plate under the bottom chord. All horizontal truss connections are made by means of double welded lap joints that allow about 2 in. horizontal adjustment. This is to provide for possible misalignment.

After the trusses are set the installation of the wire rope braces may be completed. The loose end of the cable is brought into approximate position, marked, and then cut. The bridge socket is made fast to the cable by means of molten zinc and then attached to the turnbuckle. The cables are tightened in rotation, care being exercised to keep piling plumb. A certain amount of initial tension is put in all cables; this being done solely by using a standard lever arm when rotating the turnbuckle nut and keeping the piling plumb.

The setting of the trusses as well as the placing of drilling equipment on the completed platform is handled by the crane on the work barge.

Piling are protected against corrosion by the application of the proper bitumastic compounds. This treatment covers the exposed portions of the piles and extends 12 ft below the water line. Structural steel receives a similar treatment. The galvanized cables

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receive alternate applications of bitumastic and fiberglas tape.

Quarters Building

A brief description of the quarters building, which occupied one end of the platform, may be of interest. This is a two story structure 30 ft by 70 ft in plan. It was constructed and completely equipped in Houston, then transported by barge to the site. It was necessary, however, to build the house in three sections in order to bring the weight within the lifting capacity of the 50-ton crane on the work boat. In addition to the customary requirements, the steel frame of the building was proportioned to permit lifting without undue distortion. A special lifting beam was used for handling the three sections. Features of the structure include marine plywood inside and outside of walls, fiberglas insulation, aluminum windows and storm shutters, linoleum floors, metal roof, etc. A portion of the lower floor was designed for mud storage.

A point of further interest is that the roof was originally designed to permit the landing of a helicopter. The need for this service, however, never developed. At any rate the heavy roof was not wasted as it furnished a convenient support for the well surveying hoist. What effect the vibration of this machine had on the shift sleeping below is not known. So much for construction for the present.

Structures That Failed

It is generally known that two small structures of the type described were destroyed in the hurricane of last October. These platforms were considered to be temporary as to length of exposure time in the Gulf. It was expected to complete the exploratory drilling in short order and before the storm season. However, actual events were somewhat off the anticipated schedule.

Each structure was 38 ft by 66 ft in plan, supported by six 30-in. piles. Depth of water was 45 ft. Cable bracing was used as described previously except that transverse bracing cables were fastened to outside anchor piles due to the narrow width of the structure. For the convenience of the attending vessels during operations, the deck was placed only 17 ft 6 in. above water level. This risk of not having the deck higher above possible wave action was known.

At the time of the storm, the derricks had been erected. No further installation of equipment had been made.

One of the structures was a complete wreck, ending up on the bottom. Although the other survived, it was leaning about 15 deg out of plumb in the direction of the long axis of the platform. A study of available evidence following the hurricane indicated the passage of waves higher than the deck of the platform and in a direction parallel with the long axis of the structure. Planking was ripped from the deck and piled against the derrick base. A steel box 30 ft long, 8 ft wide, and 4 ft high was moved about 25 ft from one end of the platform to the base of the derrick. As the deck of the structure was 17 ft-6 in. above normal water it would appear reasonable to assume a wave crest 20 ft above this datum.

If we assume a storm tide of 2 ft and a wave crest two-thirds wave height above Gulf level, the waves must have been 27 ft high measured from crest to trough. Thus the flat surfaces of the deck beams and truss members received the full impact of the waves.

This failure presented the opportunity for an approximate check of the wind and wave forces acting on the structure at the height of the storm. Such a stress analysis was made by ourselves and, I understand, by others interested in work of this nature. The information contained in Mr. Walter H. Munk's paper "Wave Action on

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Structures" was used in determining the forces resulting from wave action. The results of this study indicate fair agreement between actual and calculated forces.

Assuming a likely wind velocity and a 27-ft breaking wave, both acting parallel to the long axis of the structure we arrived at a cable brace load that exceeds the breaking strength of the cable by some 20 per cent. It does not seem reasonable to believe, however, that all the assumed forces of wind and wave would act simultaneously and this thought finds support in the fact that there were no broken cables on the structure left standing. It was discovered that the wire rope clips that fasten the bight of the cable in the turnbuckle connection had slipped and allowed the structure to lean. Clips were used, unfortunately, on these temporary platforms.

Regarding the structure that went to the bottom it would appear logical to assume that this same slippage occurred to a greater extent and caused failure of the piles by bending. When the wreckage of this structure was cleared off the bottom it was found that the piles had collapsed and broken at points that averaged about 10 ft below the mud line.

It may be that the popular conception of construction operations in the Gulf visualizes floating equipment tossed about by waves while men try desperately to synchronize the task at hand with the roll and pitch of the craft. Such an idea could not be more erroneous.

It is true that the Gulf is subject to squalls, southerly gales, hurricanes and so on, but fortunately, a considerable proportion of fair weather time remains for construction. Generally speaking, the best months for working are from July through November which, of course, includes the hurricane season. During these months the sea is usually calm. Advance warnings of hurricanes permit ample time for making port (if we exclude the "sneak" blow of last October).

The question naturally arises as to the work limitation imposed by the height of the waves. We have found that pile driving is not feasible in waves exceeding 4 ft in height. The setting of steel and the handling of moderate loads can be carried on, however, in 6-ft waves. Any heavy lifting or transference of large cumbersome units is confined to a calm sea.

Thus it can be seen that a contractor working under a lump sum agreement must include in his costs an allowance for standby expense when, although he is ready to work, he must await favorable weather conditions. Sometimes after loading up, checking the weather and putting to sea he arrives at the location only to discover that some waves have come up in the meantime. He must then decide whether to go in or anchor at the site in the hope that the weather will change for the better.

It is most interesting to observe the ingenuity and resourcefulness of the "landlubbers" who have gone to sea. Similarly, those grounded in the salty traditions of floating craft have approached the problem with an equal show of inventiveness from their point of view.

Among the members of our society who are performing outstanding work in this field are C. Glenn Cappel, director for the 15th district, who was awarded the construction engineering prize of 1948 for his paper, "Steel H-piles and Pipe Bents Support Deep Water Drilling Platform," and Thomas F. Seale, who has pioneered the use of small drilling platforms in conjunction with floating craft for drilling operations. ***

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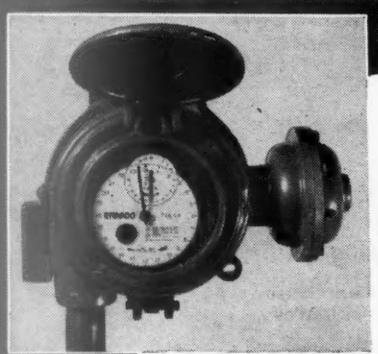

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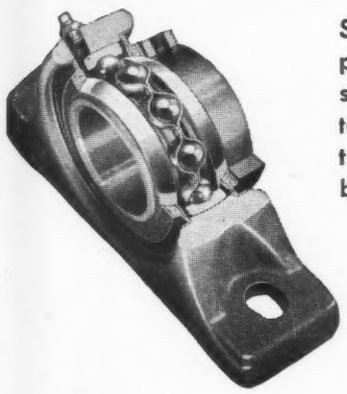

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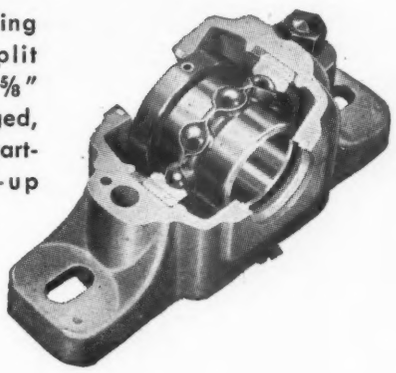

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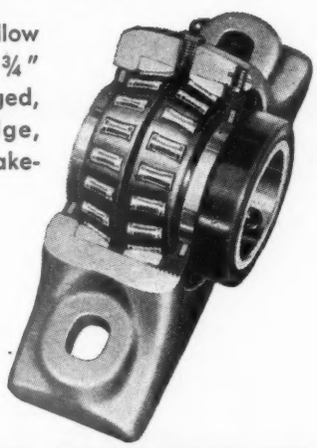

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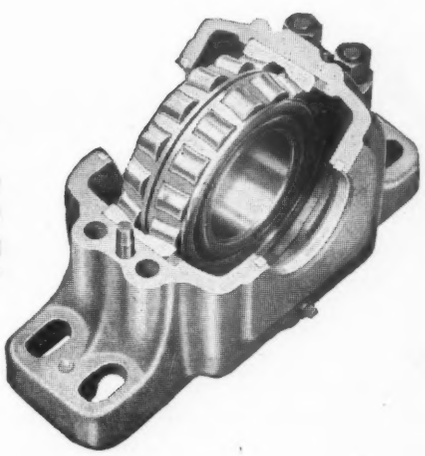

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Aerial Mapping Speeds Mozambique Survey

C. M. HODELL*

AERIAL mapping is expediting the exploration of the Mozambique Gulf Oil Company's 47,000-square mile concession area in Portuguese East Africa. The aerial reconnaissance is being performed* with precise mapping cameras and the high sensitivity ariborne magnetometer.†

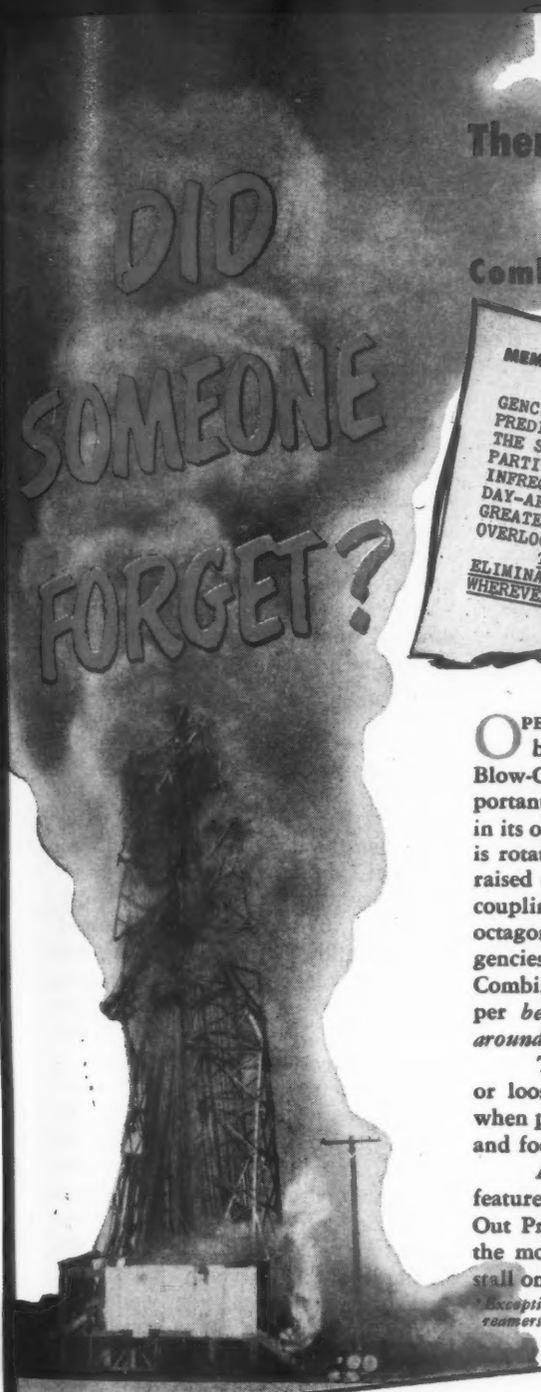
The aerial survey began last July, and the flying work has just been completed. The map compilation began soon after the survey was begun, and the first preliminary aerial magnetic maps were delivered recently to the oil company. During the next several months, all the magnetic data will be compiled in final form as precise aerial magnetic maps. These maps will be on the basis of extensive study and evaluation by Gulf Oil Corporation's geologists and geophysicists. The magnetic data serve as a guide toward areas of particular interest, and, where necessary, ground studies by other methods will be undertaken.

The aerial photographs that were made to guide the survey plane on its airborne magnetometer flights over the concession area are being assembled into photo mosaics for later development planning. The photographs have also been used by Gulf's geologists for stereoscopic study of areas of particular interest.

Aero Service Corporation, whose domestic and foreign aerial mapping is well known in the oil industry, is making the aerial survey under contract with the Mozambique Gulf Oil Company, a wholly owned subsidiary of the Gulf Oil Corporation. Aero Service is the first American company to undertake aerial surveys on the African continent.

The aerial survey crew numbers only 10 men: project engineer, chief pilot, co-pilot, crew chief, photographer, a two-man magnetometer staff, and three men to process the magnetic data. A modified DC-3, flown from Philadelphia to Africa, was used as the mapping-magnetometer plane.

*Vice president, Aero Service Corporation, Philadelphia, Pennsylvania.



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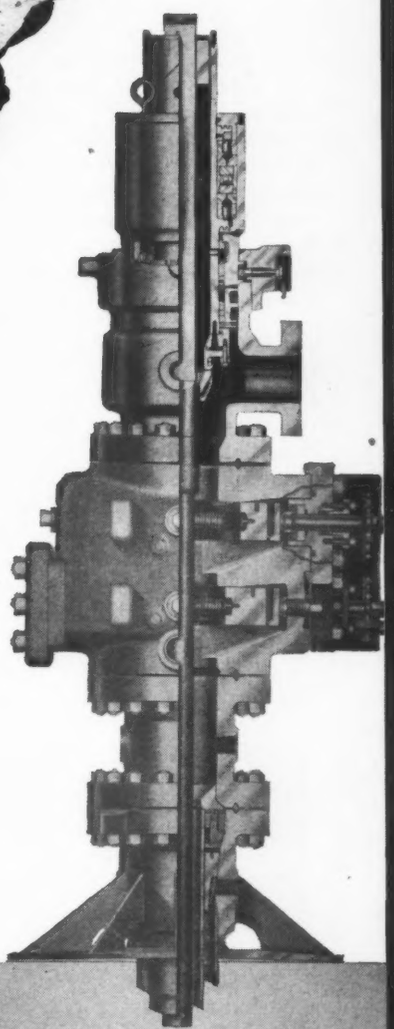
** Excepting, of course, such abnormally large diameters as bits and reamers.*



The Shaffer Type 46 Combination Rotating Blow-Out Preventer and Stripper with the Shaffer Double Cellar Control Gate and Shaffer Combination Landing Base Head—the ideal pressure control hook-up for modern drilling operations.

Additional Unique Advantages

Seals Around Any Shape: The Shaffer Combination Rotating Blow-Out Preventer and Stripper expands and contracts automatically to maintain its pressure-tight seal around any shape and any diameter in the drill string (except such abnormally large diameters as bits and reamers). It seals off around square, hexagon, or octagon kellys—around pipe, couplings, tool joints and drill collars . . . all without manual adjustments of any kind!

Continuous Seal: As outlined above the seal around the drill string is always maintained while the drill string is in the hole. This continuous seal and automatic adjustment permits the drill string to be stripped in and out of the well without pressure leakage. Yet the pipe is run in the same manner as in conventional drilling operations!

Quick Release: To run such large tools as bits or reamers through the unit, simply pull a spring latch, rotate the bonnet 1/6th turn and the complete rotating assembly is readily withdrawn from the body above the bit or reamer. When going back into the hole simply reverse the operation. It's quick. It's simple!

Space-Saving Compactness: Not only is the Shaffer Combination Rotating Blow-Out Preventer and Stripper unusually compact, but flow connections incorporated directly into the body eliminate need for spools or other accessories for overflow connections. Vertical height of drilling riser is kept at a minimum!

Negligible Wear: Since the Stripper Rubber rotates with the kelly—not around it—there is practically no wear on the rubber. Maintenance is negligible!

Space does not permit describing all the advantages built into this unit . . . the unique bearing design that absorbs both radial and thrust loads . . . the flexible steel latches that protect the Stripper Rubber against extrusion . . . the positive kelly drive that handles all driving loads . . . and many other advantages. See your nearest Shaffer representative for the full story or write direct!

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Field Headquarters

Mozambique Gulf Oil Company has established its operational base for the survey at Inhambane, a small coastal village in southern Mozambique, with a population of less than 5000—mostly natives. This is also the base for Aero Service's staff, who work under the direction of J. C. Heggblom, Gulf's manager of their entire Mozambique exploration program. The village has a grass landing field, which was adequate for the survey plane, except during the rainy season. Inhambane's harbor facilities were used for the shipment of survey equipment, spare parts, aviation gasoline, and other supplies. The base is central within the survey area, so that little time was lost in flying to and from the section to be mapped in each day's aerial work.

Inhambane is about 300 miles from Lourenco Marques, the capital of Portuguese East Africa and a noted resort city. This African "Miami Beach" boasts fine hotels, theaters, swimming pools and golf courses, as well as striking modern architecture. Within only 50 miles of Lourenco Marques great elephant herds roam the countryside, and all types of game are found in this hunter's paradise.

According to Aero Service's flight personnel, Mozambique from the air resembles our own tree-covered coastal plains. The concession area, situated in the southeast part of the country, is chiefly grassy flatlands, marked by few rivers and streams, and dotted here and there by native villages. The country's climate is like that of Florida—tropical, quite hot during their summer, and with a rainy season from November to February or March.

Photographed from 15,000 Ft

The mapping plane, at an altitude of about three miles, covered Mozambique's savanna in a series of overlapping pictures. These were assembled into flight maps. With these maps to guide the magnetometer flights, the magnetic data was observed and recorded accurately in relative positioning. The data was pinned down in absolute positions by integrating the flight maps into a radial plot, related to geodetic positions established by the Mozambique government.

With the high sensitivity instrument developed by the Gulf Research and Development Company, variations as small as two gamma were recorded from the air in a continuous trace. After inspection of the magnetic data by Gulf's field staff, the records were air-shipped to Philadelphia where Aero Service's home office data staff assembled them into precise aerial magnetic maps. Ground methods of collecting magnetic data would have required years of work by field parties who would have been exposed for long periods to the hazards of African bush operations.

Weather permitted airborne magnetometer flights on an average of five days out of seven. About one day in seven was completely clear of haze and clouds and ideal for aerial photographic work. Flying was done about 25 days per month, with the crew's days off on a weater-permitting basis. The plane's position in flight was recorded continuously with the Sonne strip camera, so the flight path could be reconstructed precisely on the photo maps.

The Supply Problem

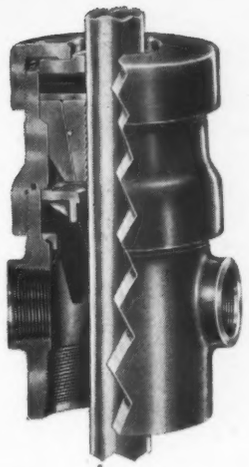
The problems of the Mozambique Gulf Oil Company's aerial survey are those found in most foreign work, according to Aero Service personnel. For example, aviation gasoline was needed in large quantities in remote areas where only small stocks are maintained. Supplies had to be transported more than 10,000 miles — a matter of ten weeks or so by boat, or about seven days by air. Complete replacement parts were at hand, for the lack of a small vital part could slow the whole operation, as they could not be obtained locally. Government cooperation was important, and the Portuguese East African government was very helpful in such matters as customs clearances, visas, radio licenses, etc. The Mozambique Servico de Industria Minas e Geologia (The Government Department of Mines and Geology) was also cooperative.

Aero Service spokesmen say that geologists regard many areas of Africa as promising ones for rich discoveries of minerals of worldwide economic importance, as well as for new oil resources. They believe that the geologic exploration of this continent is just beginning.

During the rainy season in Mozambique, the company performed a large aerial mapping-magnetometer survey in the Union of South Africa for mining interests, and more exploration work in other areas of the Dark Continent is being discussed with several other companies. The aerial exploration of Africa has been marked by a solid operational smoothness, and the airborne magnetometer continues to perform as a stable, swift reconnaissance tool for the oil and mining industries in this new area. ★ ★ ★

Coastal area from three miles up. Underwater details show at right.

Heading for the field...and years of dependable service



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NEWS

Oil Recovery Research

Oil fields of the nation that have been yielding petroleum for years may still have as much oil underground as has been taken out.

It is estimated that about 700,000,000 bbl are still awaiting secondary recovery in the Bradford, Pennsylvania, field alone.

The Penn Grade Crude Oil Association is sponsoring a project at Armour Research Foundation of Illinois Institute of Technology to find a way to obtain more of the oil trapped in the porous sandstone of the oil reservoirs.

Only about 30 per cent of the oil in any pool is obtained in the primary pumping, according to Dr. John E. Barkley, supervisor of physical chemistry at the Foundation. About 70 per cent remains in the pores of the stone in which it is trapped. More oil is recovered by pumping water into the ground and forcing the oil out of the reservoir formations. This method of secondary oil recovery may produce as much as another 30 per cent of the oil originally in place.

At most, according to Barkley, only about 60 per cent of the oil in any pool can be brought to the surface by methods in present practice. Barkley's section already has run several successful laboratory tests using surface active agents. When they have determined the best possible agent that is also economically feasible, they expect to run field tests.

AIME to Meet

Leaders in the production of minerals and metals throughout the world will gather in Columbus, Ohio, September 25 to October 1. The occasion will be the mid-year meeting of the American Institute of Mining and Metallurgical Engineers.

The week-long convention will be devoted to technical sessions on coal, oil, gas, mineral benefication, pyrometallurgy, iron and steel, and other related fields. One day, Thursday, September 29, has been set aside for field trips to outstanding mineral industries in Ohio.

Advise Curbing Output

Producers of Pennsylvania Grade crude oil have been advised to continue to curb petroleum output.

George J. Hanks, president of South Penn Oil Company of Bradford, Pennsylvania, offered the suggestion while presiding at the opening session of Pennsylvania Grade Crude Oil Association's 26th annual meeting in Hotel William Penn, in Pittsburgh.

D. T. Ring of Columbus, Ohio, Association president, reminded the group of Pennsylvania oil producers that the decline in Pennsylvania crude production has not reached a point where output is in balance with refinery requirements. He said stocks of Pennsylvania Grade crude on hand May 28 totaled 3,102,000 bbl, a gain of 468,000 bbl over the similar date a year ago. Other speakers were James V. Brown, secretary-treasurer of the National Petroleum Council, Maclean Houston, chairman of the Association's technical advisory committee, and Joseph A. Butler, chairman of the Oil Industry Information committee for the Middle Atlantic states.

Sunray Production Officials. This is the group of superintendents which directs Sunray's producing operations in the Mid-Continent states. In the picture, left to right, front row: Alvin Summers, Oklahoma division superintendent, Oklahoma City; J. R. Vandever, assistant production superintendent, Tulsa; vice president Harder; C. C. Shreve, Kansas division superintendent, Great Bend, Kansas; Perry A. Gill, North and West Texas division superintendent, Midland; Carl E. Wilson, Gulf Coast division superintendent, Alice, Texas. In the back row, standing: V. L. (Fred) Smith, district superintendent, Wewoka, Oklahoma; Fred M. McDaniel, assistant division superintendent, Great Bend; C. F. McCarroll, technical assistant, Tulsa; C. J. Kerwin, manager of partnership operations, Tulsa; J. F. Adkisson, Jr., reservoir engineer, Tulsa; Fred Goddard, district engineer, Madison, Kansas; Lee Pruitt, district engineer, Odessa, Texas. M. S. (Steve) Patton, division engineer, Alice, Texas, was present at the conference but not when the picture was taken.

Forms New Chapter

A Southeastern New Mexico chapter of the American Petroleum Institute, division of production, has been organized at Hobbs, New Mexico. Paul C. Evans, of the Gulf Oil Corporation, Hobbs, was elected chairman of this newly-constituted group. Seventy-five oil men attended the organization meeting, and enrolled in the new chapter. Frank M. Lovering, of Shell Oil Company, Inc., Hobbs, served as temporary chairman for the meeting, at which R. H. Dunn, local district superintendent for the Phillips Petroleum Company, reviewed the history of API, and explained its purpose and functions in the industry.

M. B. Moseley, Gulf Oil Corporation, was appointed to serve as secretary-treasurer. Other officers elected at the meeting were: First vice chairman, Charles D. Sands, The Ohio Oil Company, Hobbs; second vice chairman, Ralph L. Gray, Buffalo Oil Company, Artesia; and third vice chairman, W. M. Halloway, The National Supply Company, Hobbs, New Mexico.

Safety Clinic Meets

The fourth annual Safety Drilling Clinic of the American Association of Oilwell Drilling Contractors, closed a two-day session in Dallas, Texas, recently, with a record registration of nearly 200.

With personnel from drilling contracting firms, oil producing companies, and service companies participating, the meeting featured a conference discussion on the practical application of accident prevention work. Contractors, toolpushers, and superintendents were called upon to analyze, in the meeting, their concept of "safety" and how it could best be accomplished under actual operating conditions encountered in the field.

Delegates decided to hold the fifth annual Safety Drilling Clinic in Dallas in 1950. The date and details of the program to be announced at a later date.

Cuyama Oil Discovery

Richfield Oil Company has discovered a new major field about 5½ miles east of the present Cuyama (Russel Ranch) field, California, located a year ago. The discovery well, which was brought into production May 4, came in at the rate of 5088 bbl of 34 gravity oil and 1,500,000 cu ft of gas per day. Production is from lower Miocene sands and the structural trap is the result of faulting. The reservoir sand is similar to that of Russell Ranch and White Rock and over 300 ft of permeable oil sand was cored lying between 4100 and 4392 ft.

Phillips' Canadian Deal

Husky Refining Company, Cody, Wyoming and Husky Oil and Refining, Ltd., of Calgary, Canada, have joined in an agreement whereby Phillips Petroleum Company will acquire an undivided one-half interest in all of the petroleum and natural gas rights of the Husky Companies in the Provinces of Alberta and Saskatchewan, Canada, except the black oil rights in the Cretaceous formation of the Lloydminster area.

This deal involves rights under approximately 4,850,000 acres of lands in these two Canadian Provinces.

Phillips and Husky have agreed on an extensive program for the joint maintenance, exploration, and development of these properties.

Holds Annual Election

The Conservation Committee of California Oil Producers held its annual election of officers at its organization meeting recently, electing Lot Bowen, of Western Gulf Oil Company, chairman for the ensuing 12 months.

According to Bowen, the Committee strives to increase the ultimate yield of petroleum from California's oil fields by encouraging efficient production practices. All of the Committee's work is carried out on an entirely voluntary basis. He stated that the district committee members are elected by vote of the oil producers in the state to represent the various fields and districts. There are 945 operators with a total of 26,497 oil wells in California. During May 1949 crude oil production was 929,000 bbl per day.

Other officers elected were: first vice chairman, T. W. Bell of The Texas Company; second vice chairman, Ross McCollum of National Oil Company; and secretary, Henry F. Power of General Petroleum Corporation. The nominating committee was appointed with Joseph Jensen as chairman.

Production in Saudi Arabia

Crude oil production in Saudi Arabia during May amounted to 15,566,920 bbl, or an average of 502,159 bbl per calendar day, compared with 523,555 bbl per calendar day in April.

Crude processed at the company's refinery at Ras Tanura amounted to 4,187,953 bbl, or an average of 135,095 bbl per calendar day. In April the average was 141,441 bbl per calendar day.

Crude oil production for the first five months of 1949 amounted to 77,602,237 bbl, an average of 513,922 bbl per calendar day. Crude run in the refinery for the same period was 20,054,284 bbl, an average of 132,810 bbl per calendar day.

Production Engineers Meet

More than 180 engineers, technical specialists, and officials representing operations of Gulf Oil Corporation in the United States, Canada, South America, Europe, and the Middle East met in the largest engineering conference in company history in Pittsburgh, Pennsylvania, recently. The conference was the fifth in a series inaugurated before the war to study petroleum engineering problems and exchange information on production operations.

Delegates heard 35 papers presented at the seven technical sessions, held in Hotel William Penn.

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NEWS

Appoint Committee Members

Heber Beardmore, Beardmore Drilling Company, Wichita, Kansas, and Chairman of the Kansas Chapter of American Association of Oilwell Drilling Contractors, has announced appointments to three committees. This newest A.A.O.D.C. Chapter, was organized April 21. Other officers include C. H. Todd, Rine Drilling Company, vice chairman, and Carl Sebits, Pickrell Drilling, Wichita, secretary.

Appointments are as follows: Heber Beardmore, Beardmore Drilling Company, chairman; C. H. Todd, Rine Drilling Company, vice chairman; and Carl Sebits, Pickrell Drilling Company of Wichita, secretary.

For the program committee: W. J. Coppinger, Coppinger and Southern, chairman; Jim Adkins, Adkins Drilling Company, Great Bend; Dwight Wilson, Quaker Drilling Company, Wichita; and J. D. Ferrell, J. D. Ferrell Drilling Company, Great Bend.

On the membership committee: Fred Stickle, Stickle Drilling Company, Great Bend, chairman; Chester Williams, Flourney and Williams, F. M. Sellany, Earl F. Wakefield, and W. S. Brunson, Brunson Drilling Company, Wichita.

Publicity committee: Bill Burks, Derby Drilling Company, Wichita, chairman; F. M. Stevenson, Signal Drilling Company, Great Bend; H. D. Shreve, Heathman-Honaker Drilling Company; and Charles Searle, Petroleum, Inc., of Wichita.

The Board of Directors is to consist of three officers and three committee chairmen.

Form Scout Check

A second oil scout check has been formed in the Rocky Mountain region, due to the increase in leasing and exploration activity in Montana and North and South Dakota.

Officers are Robert Willis, The Texas Company, president; Joe Seymour, Phillips Petroleum Company, vice president, and Leonard Scott, Shell Oil Company, secretary-treasurer. Eight companies are represented in the new check, and meetings are held each Thursday.

Cuts Drilling Costs

Expense of moving rigs has always been a big item in the cost of drilling, and when changes of location in the same field are very far apart, it has often been the factor which determined whether or not there would be further exploration.

In the San Ardo area, California, where moving costs have been an important factor, Thomas P. Pike Drilling Company of Los Angeles, has materially reduced the cost of drilling wells through the use of a portable rig.* They have made moves between locations in as little as 13 hours, starting from actual tearout, to spudding in on the new site. This type of mobile operation not only reduces the cost of moving equipment for the driller, but greatly increases the productive time when the rig is actually making hole.

The rig is mounted on a heavy-duty low-bed trailer body, moves on rubber tired wheels between locations, and the 96 ft mast folds down. The 14 in. pump and prime mover are also mounted on the same type of rubber tired equipment.

*IDECO H-4 Rambler.

Economist Takes Favorable View

This year and the next will be "favorable for oil consumers," according to economist Marion E. Dice.

Speaking before the American Association of Petroleum Geologists in Los Angeles, the General Petroleum Corporation executive pointed out that current crude oil production is more than sufficient for current demand and inventories are increasing.

"Two or three years ago," said Dice, "we in California thought outside or foreign crude oil might be needed in a few years to supplement our own oil supplies.

"There was serious talk of an oil pipe line from Texas to Los Angeles, but the needs of the Mid-Continent market took the Texas oil eastward instead and California was able to find all the oil it needs for the present.

"No imports now appear necessary," Dice stated.

Commenting on Canadian oil discoveries, Dice pointed out that their strategic importance to Canada and the United States in time of war would be considerable and possibly even "decisive."

IOCC Prepares Bulletin

Publication of "Summary of Secondary Recovery Projects in Kansas —1948" has been announced by the Interstate Oil Compact Commission.

This bulletin was a joint preparation of the Interstate Oil Compact Commission and the Kansas Corporation Commission. Information was compiled by Albert E. Sweeney, Jr., director of the Compact's secondary recovery division.

The report covers all water flood projects and gas injection projects in Kansas, giving such details about individual projects as production figures, acreage, and information on the producing formation. Similar reports are contemplated for the other oil and gas producing states.

Copies of this report may be obtained by writing the Interstate Oil Compact Commission, P. O. Box 3127, State Capitol, Oklahoma City 5, Oklahoma.

Drilling Ceases

Oil exploration activities have been stopped in Panama by Sinclair Oil Corporation. It is expected the company will remove its oil equipment from the country. Sinclair told the Panama government it had failed to find oil in the country where it has been exploring since 1946. The company drilled two wells, and based on the results of these tests and exploratory work it has no desire to drill additional wells.

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WHAT'S DOING IN DRILLING

Brantly Says Demand Great for Equipment

Demand for oil equipment is practically world wide, J. E. "Ned" Brantly, president of Drilling and Exploration Company, told Los Angeles, California, chapter Nomads at the Jonathan Club, recently. The statement was part of Brantly's appraisal of world markets derived from recent extensive travels in Europe and South America.

He pointed out that new equipment need continues although more oil is being produced at the present time than the world can use. The reason for this is that countries which can consume more oil have neither goods nor dollars with which to buy it. The result is that such nations are trying hard to increase production and develop their own resources so as to take care of their petroleum need. This, of course, means drilling campaigns and increased construction on a world-wide scale.

As an example of present market conditions, the speaker pointed to Argentina and Brazil, currently using about 60,000 bbl of oil a day each. Argentina, he contended, could use 300,000 bbl a day, and Brazil 500,000. But they lack the wherewithal to obtain the difference.

Our own crude oil supply is not inexhaustible either, Brantly stated, and oil from the Middle East, Venezuela, and Mexico, will be of increasing importance. Meantime, the United States will have to tighten its belt a bit, but that should not be for long, nor should industry be seriously hurt in the process.

A report was also given during the meeting by John Hurndall, associate of Edwin W. Pauley.

East Texas Gets New Well

East Texas has completed one of its biggest oil wells in recent weeks. It is the Delta No. 1 Little Lillie Hoskins, in the south Tyler Paluxy field, several miles south of Tyler.

It flowed 550 bbl of 27.1 gravity oil through a ¼-in. choke from the Paluxy formation through perforations at 7638-58 ft.

The well has given a push to development in the area. Humble has staked an offset location to the north. Work on it is expected to start immediately. The pool was discovered by the Tyler firm and opened to production in October, 1948.

Wyoming Gets New Producer

Continental Oil Company has announced discovery of a new oil producing sand in the Sussex area of Johnson County, Wyoming. Its Sussex Unit well No. 4 swabbed at the rate of 168 bbl a day from perforations at 4530-4568 ft from the Shannon sand.

This is the first Shannon sand producer, although Continental has drilled four producers in the Sussex area. The company completed its discovery in the field at Sussex Unit No. 1 for a 241-bbl a day potential through a ¼-in. choke in July, 1948. The field is near Midwest, Wyoming, 65 miles north of Casper.

Makes Utah Discovery

The first tertiary production in the state of Utah has been opened by Carter Oil Company and Stanolind Oil and Gas Company. It is the No. 1 Ute Tribal, which flowed 1600 bbl of 31.7 gravity black oil in 24 hr through open two-inch tubing. On a test for 30 hr. the well flowed between 65 and 70 bbl of oil an hr and then was shut in for tankage. It is in Unitah county.

Gas flow was estimated at 380 cu ft per bbl of oil.

The discovery well is located about 25 miles west and a little south of Vernal and something like 35 miles from nearest previous oil production. that being in the Ashley Valley field.

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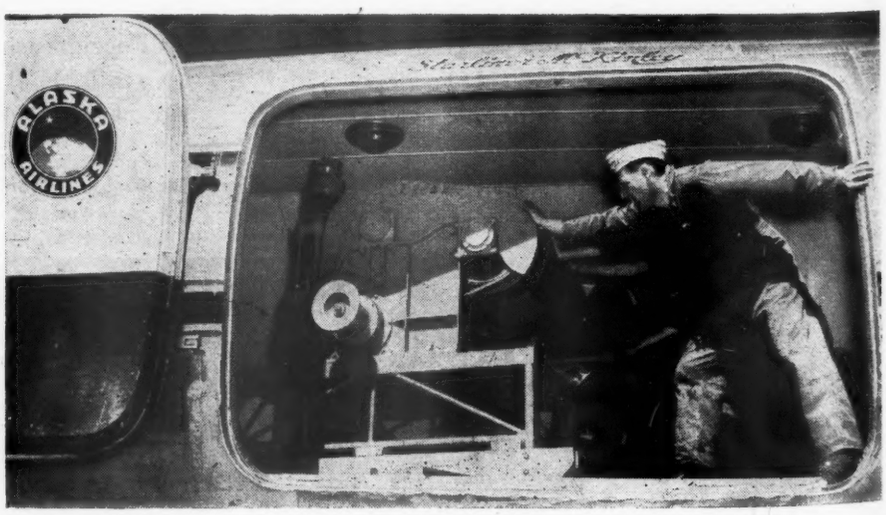
Air transportation has been used to carry a portable rig from the George E. Failing factory to a drilling site in Alaska, for the first time since the war. The drill was in operation in northern Alaska approximately 72 hours after loading in Enid, Oklahoma. Weighing 8 tons, it was especially designed to fit into the C-54 plane. The drill will be used in exploration work on the Naval Reserve. Captain G. H. Stone supervised the loading of the drill.



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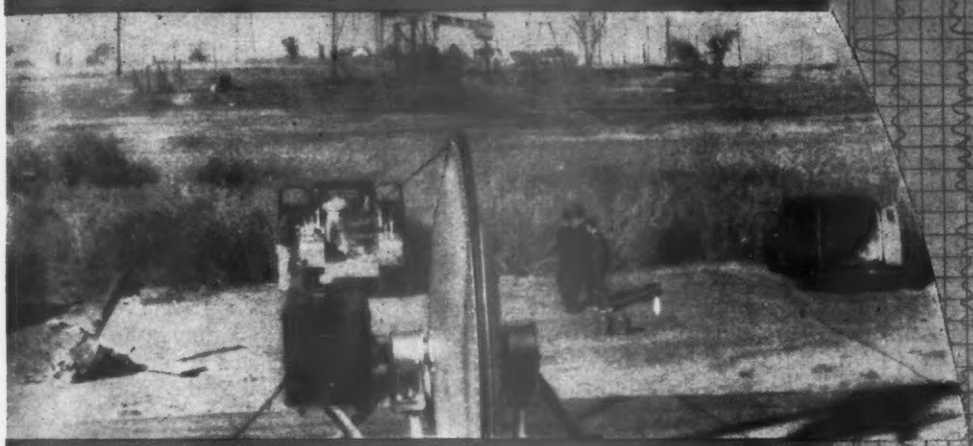

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Cut Wildcat Drilling

In the face of official reports that the government monopoly is now losing more than $22,000,000 a year, Petroleos Mexicanos is cutting down on expenditures for geophysical studies and wildcat drilling.

All six crews engaged in geophysical studies there will be off the job by June 15 as Pemex has exercised a 30-day option to cancel the contracts, according to officials of Geophysical Service, Inc., Dallas, Texas.

J. Weldon Thomas, head of the Geophysical Services, Inc., offices, said most of the geophysicists stationed in Mexico on the Pemex contracts which date back to June 21, 1944 have been placed on jobs in Canada and the United States.

Drill Shallow Well

One of several recently completed in Garvin county, Oklahoma, is Shell Oil Company's shallow 1227 ft well, No. 1 Blythe. After running tubing, the well flowed 160 bbl of oil without any water, in six hours through one-inch choke.

Producing Zone Added

Cities Service Oil Company (Delaware), has given the Dollarhide pool of Andrews county, Texas, another producing zone. Its Cowden E No. 1 flowed 449 bbl of oil in 20 hours from perforations in the Clear Fork lime from 6545 to 6650. Previously, this Cities Service well had extended Devonian production in the Dollarhide pool one mile north when it flowed 16 bbl of oil an hour from perforations from 7755 to 7800 ft.

Kansas Well Drilled

A new oil well, producing 110 bbl a day, has been drilled in Independence, Kansas. E. W. Hayes, of Independence, and his partner, C. L. Hester, Tulsa, Oklahoma, announced they have drilled a producer in the quarry of the Universal Atlas Cement Company plant in Montgomery county. It is the second well drilled in the quarry location. The first one is producing 30 bbl of oil a day.

Test Colorado Wildcat

Gas possibilities are being tested at the No. 1 Unit, wildcat in NE NW of 8-8s-102w, Garfield county, Colorado, by Kerr-McGee Oil Industries.

The well was drilled last year by Phillips Petroleum and Kerr-McGee to a depth of 4240 ft to get granite. Pipe was cemented at 3516 ft and work was shut down through the winter.

A drill-stem test at 3516-60 ft showed an estimated 6,000,000 cu ft of gas a day, the gas having a carbon dioxide content of 58.7 per cent.

Italy Gets First Well

As a result of tests in Cortemaggiore 1 about 20 km east and slightly south of Piacenza in Northern Italy, enthusiastic reports have come out of the country, seemingly justifying long-standing belief of many geologists that crude production will be found in the Po Valley area.

On short production tests the well flowed at the rate of about 25 tons (175-200 bbl) of light-gravity oil accompanied by large quantities of gas. The production was from perforations in an interval between 1500-1600 m. (4900 to 5250 ft).

Cortemaggiore 1 is about 1 km west of the No. 2 well that was completed as a major gasser. The No. 2 well on a drill-stem showed a considerable quantity of high-gravity oil or condesate. The Cortemaggiore structure appears to be a long east-west fold, and Azienda Generale Italiana Petroli, a government-owned company, is reported to be preparing to drill No. 3 well to the south.

Production Seen For Velma Pool

Gulf Oil Company has made initial test on the east flank of the Velma pool of Stephens county, Oklahoma, where the No. 1 James, in SW SE NE of 32-1s-4w, is pointing the way for more work in the extension play.

Drilled to 6299 ft, the 7-in. pipe was cemented at 6131 ft, and after bailing down, the well kicked off and flowed 708 bbl of oil in 15½ hr through casing.

Completes Extension Well

Richfield Oil Corporation has completed its South Cuyama, California, extension test well, F. K. Perkins No. 17-31, flowing at an estimated rate of 5000 bbl per day of light gravity oil. The well is located 1¼ miles southeast of Richfield's discovery well of the South Cuyama field, Homan No. A-1. The Perkins' well encountered the top of the oil zone at 3965 ft and was completed at a depth of 4360 ft. The well was started June 18.

Has 12 Scurry Wells

T. M. Martin, president, has announced that Lion Oil Company has completed five new oil wells in the Diamond M Field of Scurry County, Texas. This brings to twelve the total wells completed in this field by Lion since the field was discovered in January, 1949. As the Diamond M Field is being drilled with one well to each 40 acres, 480 acres have already been proved out of the 5400 acre block under lease to Lion. Lion's discovery well was located in the approximate center of the block.

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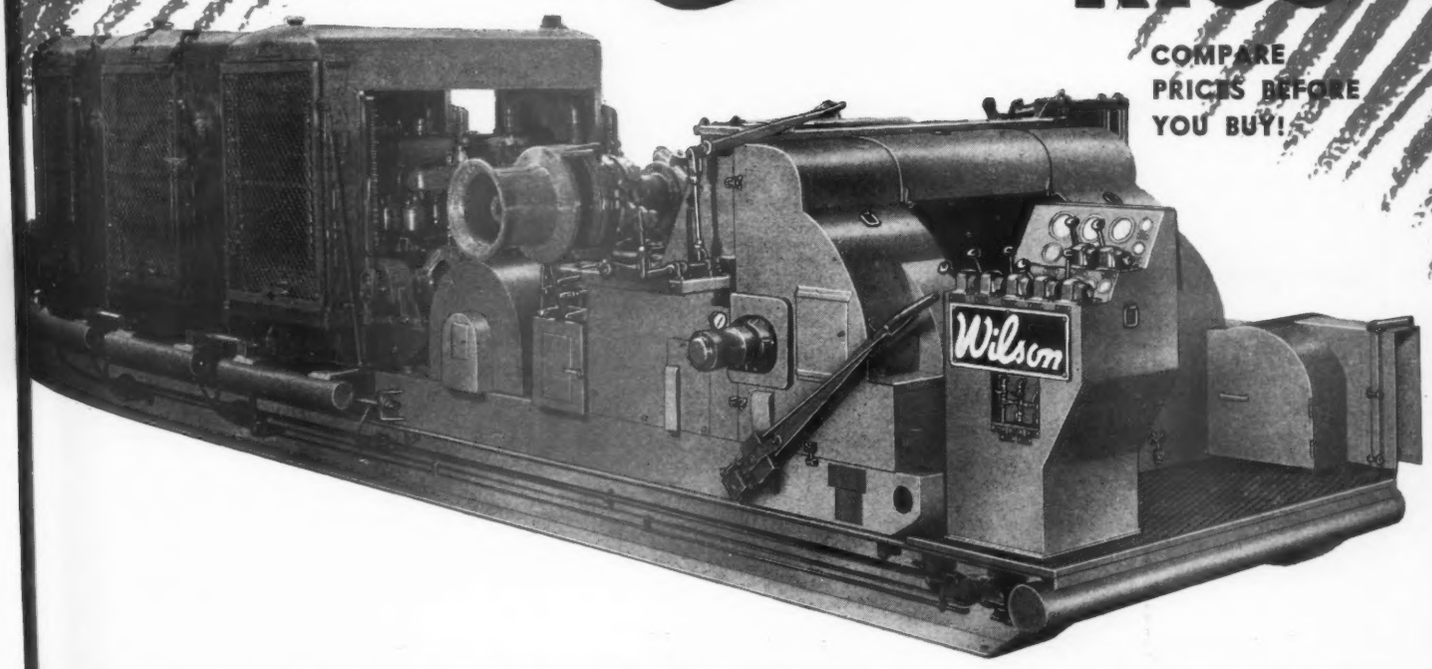

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EXPLORATION ACTIVITIES

Oil Field Evident

Good production in Kaufman County, Texas, from the Paluxy sand, one of the more prolific pay horizons in East Texas, was indicated recently on the basis of a formation test made at a wildcat in the Cedarvale area east of the county seat.

The discovery was drilled by R. W. Fair, Tyler, on land owned by Angus Wynne, Longview, Texas. The well topped the Paluxy by driller at 4965 and drilled in two feet. A core from 4967-87 got fifteen feet of saturated oil sand.

The well listed a potential flow of 230 bbl daily through 10/64-in. choke. Flowing tubing pressure was 280 lb. Ratio and oil gravity were unreported although earlier gravity had been given as thirty-one.

This gauge is about half the flowing rate reported for the well on a quarter choke. A 21-hr test through this size choke produced 418 bbl.

Location is on a 150-acre tract in the B. S. Newman survey with footage 467 ft from the north and 2000 ft from the east lines of the survey.

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Wabaunsee County Leads

Carter Oil Company's major wildcat strike is in Wabaunsee County, Kansas, in the northeastern section of the state. Latest discovery in the new Davis Ranch pool is Carter's No. 1 G. H. Davis, in the state rating of 2580 bbl of oil daily from the Viola lime at 3199 to 3206 ft. The oil tests 29 gravity. The well is 10 miles east of gas production in the Alta Vista pool in Morris county.

Wabaunsee County, with one well good for 2580 bbl daily, led other counties in new production.

New Well In Nebraska

A discovery well has been drilled in Cheyenne County, Nebraska, by The Ohio Oil Company. The well is the No. 1 Eggings in the NENENE of Section 11, Township 15 N, Range 49 W. The elevation is reported to be 4215 ft with top of the sand (probably the muddy of the Dakota series) at 4401 ft. Coring was done from 4403 to 4429 ft with full recovery. Saturated sand was from 4403 to 4424 ft. Pipe (9⅝-in. size) was set at 4403, and 2½-in. tubing was run to 4407 ft without a packer. After swabbing, the fluid level was reported at 3100 ft with a 700 ft build-up overnight. The pay formation is reported to have been drilled about the rate of 6 min per ft.

Ohio is also starting work on No. 1 Knievel NE SE SE 2-15n-49w, a north offset to its discovery well in Cheyenne county.

The discovery has attracted considerable attention as it is the only oil producer in Nebraska outside of the Falls City pool in the extreme southeastern part of the state. It is pumping between 300 and 500 bbl of oil daily from Muddy sand at 4403-29 ft.

Geologists Meet

Shell Oil Company production geologists from the East of the Rockies Territory met for their annual conference on June 7, 8, and 9 in the Houston, Texas, regional office. The conference included those members of the production staffs formerly called "sub-surface" engineers but now known as production geologists.

Chairman of the conference was O. Wilhelm, regional production geologist. Twenty-three members of the staff attended the conference, of whom 18 were delegates from the four areas. Joe Chalmers, exploitation manager, Houston division, was present. The conference brought company geologists up to date on various problems.

North Dakota Tests Made

The central and western parts of North Dakota are being invaded by oil company land men and survey crews in a search for new oil and gas fields. Major oil companies have leased 7,000,000 acres of land, one-sixth of the state's area. Most was acquired in the past two months.

Two tests are drilling. One, northwest of Minot, is at 6368 ft. Operators have reported oil staining and odors in drill cuttings of the Madison lime in the last 300 ft. These reports have not been certified by major company scouts or geologists, and are considered of doubtful significance.

Six miles north of Antler, North Dakota, but located at Lyleton, Manitoba, over the Canadian border, the Souris Valley Oil Company, Inc., test is at 3500 ft.

Both wells are planned to go to 7500 ft. The present rush of oil firms into the state was precipitated by the development of fields near Edmonton, Alberta.

Reach Cooperative Basis

Conclusion of a cooperative program looking both to the completion of petroleum exploratory work and to test drilling on the properties of their companies in the Kuwait-Saudi Arabia Neutral Zone was announced by Ralph K. Davies, president of the American Independent Oil Company, and J. Paul Getty, president of the Pacific Western Oil Corporation.

The Neutral Zone, a semi-desert area which lies between the independent Shaikhdom of Kuwait and the kingdom of Saudi Arabia on the Persian Gulf, is held jointly by King Ibn Saud of Saudi Arabia and Shaikh Ahmad of Kuwait. American Independent obtained the oil rights to the Shaikh's undivided half interest in the area in June, 1948, while Pacific Western was granted its concession by King Ibn Saud early this year.

Both Davies and Getty expressed satisfaction over having reached a cooperative basis for the development of the concessions, and confidence in the outcome of their Arabian venture.

Elect Officers

Officers elected for the 1948-49 season by the Mississippi Geological Society were: E. T. Monsour, consulting geologist, president; C. E. Buck, Skelly Oil Company, vice president; W. H. Knight, Union Producing Company, treasurer; F. T. Holden, Carter Oil Company, secretary.

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Makes Alberta Discovery

A 2592 bbl per day oil well, the seventh well on its Redwater section of 640 acres, has been brought in by Sunray Oil Corporation and Pacific Petroleums, Ltd., in LSD Sec. 3-58-22W of 4th M, Alberta, Canada. The P.A.S.C. Redwater No. 2 is producing 35 deg gravity oil, on potential test, at a rate of 108 bbl per hr. Casing was set at 3240 ft in the D3 zone, total depth 3252 ft. Sunray and its Canadian partners have five other proven locations on their Redwater tract. P.A.S.C. No. 3 is drilling and nearing completion.

The Sunray and Pacific Petroleums No. 1 on their Dallas block LSD 9 Sec. 19-59-R23 West of 4th M, has penetrated a gas sand at 26-2700 ft indicating natural gas flow of 10,000,000 cu ft daily. This gas and other gas in the 30,000 acre tract will be available for the proposed Westcoast Transmission Company's international pipe line in which Sunray is interested.

The oil industry is rushing plans for refinery expansion in the Canadian prairie provinces and for pipe lines to permit expansion of markets for the Dominion's crude oil.

Companies Join For Canadian Exploration

K. S. Adams, president of Phillips Petroleum Company, has announced that that company and two others have joined in the exploration and development of about 4,850,000 acres of land in Saskatchewan and Alberta provinces of Canada.

Under the agreement, Phillips will receive an undivided one-half interest in all petroleum and natural gas rights of Husky Refining Company, Cody, Wyoming, and Husky Oil and Refining, Ltd., Calgary, in the two provinces.

Plans Field Trip

Plans have been announced for the seventh field trip—Pre-Cambrian and Paleozoic rocks of Northern Alabama and South-central Tennessee, by the Mississippi Geological Society.

The trip will get under way August 23, when registeration begins at the Clement Hotel in Opelika, Alabama. The following day will be spent studying the crystalline and metamorphic rocks of eastern Alabama with Hugh D. Pallister as leader. On the 25th the group will study the geology of the Birmingham District with Arthur Blair as leader. The 26th will be spent in the Black Warrior Basin and Tennessee Valley areas with Walter B. Jones and Winnie McGlamery as leaders. The final day the group will visit the Silurian and Devonian areas of South-Central Tennessee with John R. Ball as leader.

In charge of the trip for the Society are Fred Mellen, chairman, Fred Holden, Editor, Charles Walton, arrangements, Larry Finfrock, finance.

Exploration In Australia

An extensive exploratory program is expected to get underway in Australia. One Australian oil company will begin a deep drilling campaign soon in the quest of crude oil.

W. G. Walkley, Ampol Petroleum Ltd., official, predicted the oil sands would be found at near 5500 ft, and that drilling would be carried to 10,000 ft, says a letter from Perth.

Geologists have likened and compared the rock structures on the barren desert coast 1100 miles north of Perth with the Asmari Mountain, biggest oil producer in Iraq.

Although there has not been any oil found in Australia as yet, the commonwealth companies are spending some $8,000,000 in Papua and New Guinea, and sinking one 12,000 ft test in Queensland.

Paul H. Dudley, consulting engineer of Long Beach, California, and Frank Morgan, vice president of Richfield Oil Corporation, of Los Angeles, California, have returned to America after carrying out an aerial survey.

Mason L. Hill, chief geologist of Richfield Oil, said before he left Australia that the Western Australian rock structure "would have been drilled years ago if they were situated in west Texas."

Walkley said the area is an anticline (inverted bowl) structure. Plans are under way to establish camps and supply lines in this remote region, where the nearest neighbor is a lighthouse keeper, more than 50 miles away. Cattle farms in this region are 60 or more miles apart.

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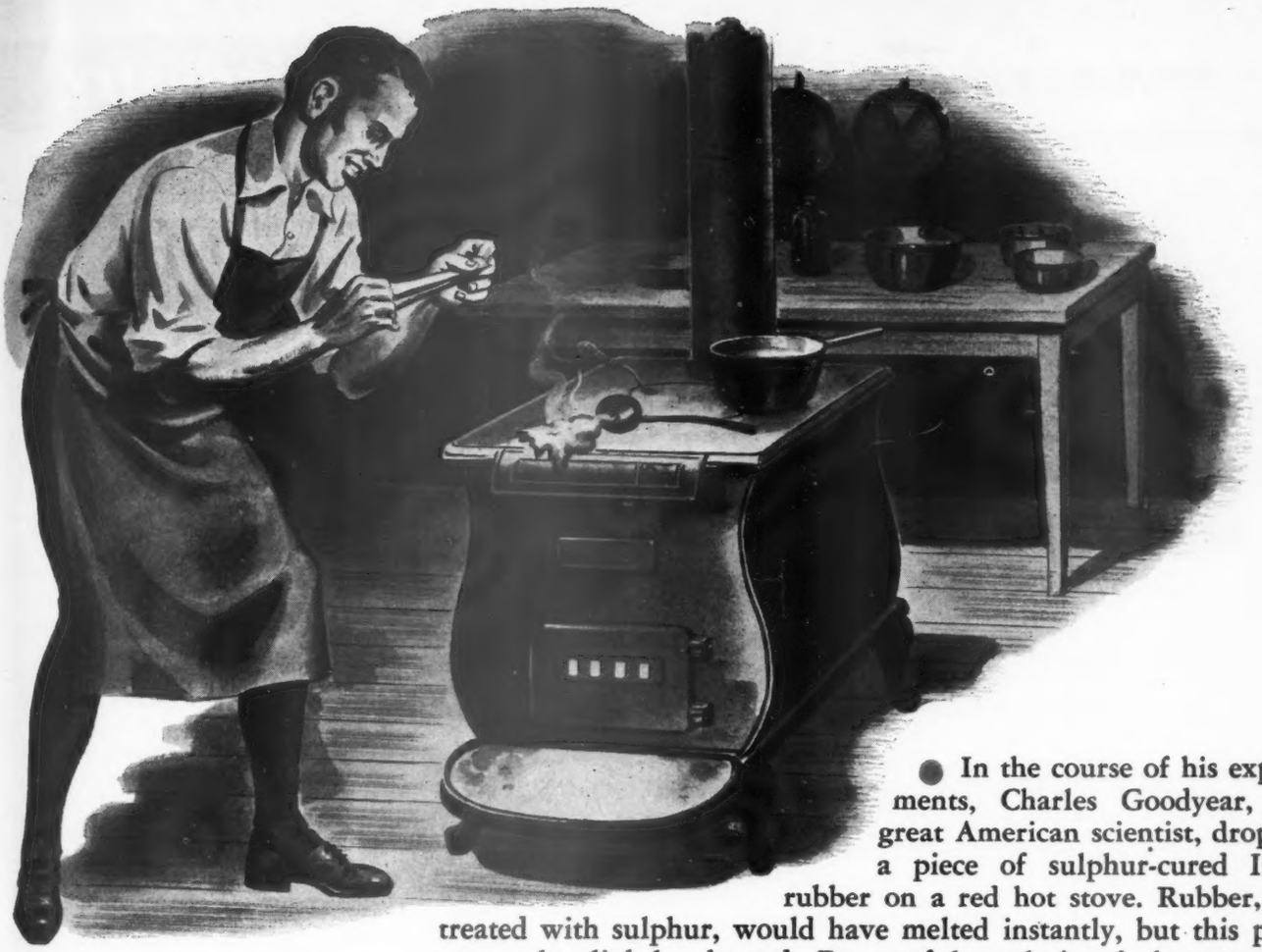

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Halbert M. McClain

▸ **Halbert M. McClain,** petroleum and chemical engineer, has announced the opening of consulting offices in Dallas, Texas. He resigned recently from the petroleum engineering department of Magnolia Petroleum Company in Dallas, where he had direct charge of secondary recovery operations and chemical engineering problems in the drilling and producing department.

McClain received his degree in chemical and petroleum engineering from Oklahoma A&M College at Stillwater. He is a native of Alva, Oklahoma, and was employed in Magnolia's producing department at Oklahoma City for about 10 years. Since 1941, he has been engaged in problems throughout the Mid-Continent and Gulf Coast areas with headquarters at Dallas.

He is vice president in charge of programs for the Petroleum Engineers' Club of Dallas and an active member of the API as chairman of the Dallas-Ft. Worth section of the secondary recovery committee. He is also a member of the AIME and the Dallas Geological Society.

▸ **Frank M. Hamner,** formerly a geologist with the Stanolind Oil and Gas Company at Lake Charles, Louisiana, is now associated with the Schermerhorn Oil Corporation at Tulsa, Oklahoma, as engineer geologist.

▸ **Earl D. Cypert,** land man for Magnolia Petroleum Company, was transferred recently from Oklahoma City, Oklahoma, to Bismarck, North Dakota, where he will have charge of land and lease matters for the company in North and South Dakota.

William A. Sherman was promoted recently from rotary driller in the Louisiana-Gulf division to marine drilling tools foreman.

▸ **C. M. Hinton** has been named manager of production and drilling for the American Republics Corporation, Craig Cullinan, president, stated.

Hinton returns to Houston, Texas, from Calgary, Canada, where he was assistant manager of the Texas Exploration Company in charge of drilling and production.

He formerly was in the operating department of The Texas Company in Houston and South Texas areas.

▸ **S. N. Jackson** of the Sun Oil Company, Dallas, Texas, is the new president of the National Oil Scouts and Landmen's Association.

He was elected at the closing business session of the group's twenty-sixth annual convention at the Shamrock Hotel in Houston, Texas. He succeeds Simon Crites of the Phillips Petroleum Company, Corpus Christi.

Other new officers include **Fred Tyner** of the Pure Oil Company, Roswell, New Mexico, first vice president; **George Saverline** of the Sun Oil Company, Shawnee, Oklahoma, second vice president; **Frank Fagan** of the Atlantic Refining Company, Wichita, Kansas, third vice president; **Chester H. Geiger** of the Carter Oil Company, Mattoon, Illinois, secretary-treasurer, and **Fred S. Alexander** of the Standard Oil Company of Texas, Amarillo, editor in chief of the group's yearbook.

▸ **M. C. Hoffman,** veteran production executive with Stanolind Oil and Gas Company, is resigning to accept the position of general manager of production and exploration for Root Petroleum Company.

Hoffman will join the Root Company on June 1 and will be at headquarters in Shreveport, Louisiana.

Hoffman has been with Stanolind since 1931 and prior to that time had 10 years service with The Midwest Refining Company, a predecessor to Stanolind.

▸ **R. M. Reeves,** marine terminal superintendent at Stanolind Oil and Gas Company's Galveston, Texas, offshore operations base, has been named production foreman at Lafayette, Louisiana.

William A. Kimbrough will replace Reeves as Galveston terminal superintendent. He was formerly a petroleum engineer in the Gulf Coast division and had supervised conversion of vessels used in Stanolind's operations in the Gulf.

▸ **John F. Conley** will assume the duties of general superintendent of Part Interest operations with headquarters in Dallas, Texas, for Magnolia Petroleum Company. Conley is at present division superintendent of the Kansas division which includes producing operations in Kansas, Illinois, Tennessee, Indiana, and Ohio.

W. B. Powers, assistant division superintendent of Magnolia's Gulf Coast division, will be promoted to division superintendent of the Kansas division.

J. J. Bresenham, Jr., assistant district superintendent at Kermit, Texas, will be transferred to Pampa, Texas as district petroleum engineer.

E. G. Blundell, production foreman at Kermit, will assume the duties of assistant district superintendent in the Kermit producing district.

Charles B. Swain, formerly specialist in the Oklahoma division producing offices, has been transferred to Duncan, Oklahoma as assistant district superintendent of the Duncan producing district.

▸ The Texas Company has announced the following organization changes:

R. F. Baker, general manager of the domestic producing department with headquarters at New York, was elected a vice president in charge of domestic producing operations. Baker has spent 33 years in the crude oil producing department of the company. He succeeds R. Ogarrio.

R. Ogarrio, who was vice president in charge of domestic producing, was made chairman of an executive producing committee which will consider crude oil production policy on a world-wide basis.

L. H. Lindeman, treasurer, was elected a vice president in charge of financial matters. He has been with the company since 1910.

Robert Fisher, assistant treasurer, was elected treasurer.

A. C. Long, assistant to the chairman of the board, was elected a vice president in charge of all foreign operations in the eastern hemisphere. Long's service of nearly 20 years with the company has been principally in foreign work.

▸ **W. D. Mackenzie,** formerly chief engineer with the producing department of Imperial Oil Limited in Toronto, Canada, has been transferred to Calgary. He will become assistant manager of the western division of the producing department.

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▸ **Campbell B. Baker** has been named plant engineer, and **Owen B. Rowley** maintenance foreman of the Burnell-North Pettus cycling plant, near Pettus, Texas.

The Burnell-North Pettus plant is being built under Stanolind Oil and Gas Company's supervision, and will be operated by Stanolind for the co-owners. It will be completed this summer.

▸ **Matthew E. Miller,** Magnolia Petroleum Company, was promoted from gangpusher in the Healdton district to production foreman in the same district.

▸ **D. B. Mason, Jr.,** has been named district landman for Stanolind Oil and Gas Company at Jackson, Mississippi. Announcement of Mason's appointment was announced by C. T. Jones, central division manager. He goes to Jackson from Stanolind's general office in Tulsa, Oklahoma, where he was contract supervisor.

Mason succeeds **W. Troy Stalls,** who has been named assistant division landman for Stanolind at Casper, Wyoming.

Stalls succeeds F. D. Manning, who has resigned. Stalls comes to Casper from Jackson, Mississippi, where he has been district landman since September, 1946. He joined Stanolind as a roustabout after his graduation from the University of Tulsa in 1936.

Phillip D. Manning, Jr., who has been district engineer at Corpus Christi, Texas, since 1947, has been named division engineer of the central division at Oklahoma City by Stanolind.

He succeeds **M. P. Huntington,** who has been transferred to the company's economic department at Tulsa.

Two other personnel shifts within the central division have been announced. They are:

James J. Johnson, petroleum engineer, transferred to the division office from Shreveport, Louisiana.

Weldon C. Julander, geologist, transferred from Albuquerque, New Mexico, to Wichita, Kansas.

Other changes in the Rocky Mountain division include:

John H. Vandenberg, Jr., plant engineer at the Salt Creek gasoline plant, Midwest, Wyoming.

Jean W. Heims, geologist, transferred to the Casper office from Tulsa, Oklahoma.

Lynn D. Ervin, field seismic supervisor, transferred to Casper from Ardmore, Oklahoma.

W. J. Moore, made party chief of a Stanolind seismograph party at Rock Springs, Wyoming.

▸ **William H. Allen,** geologist with Shell Oil Company of Canada, Ltd., is now at Calgary, Alta, Canada. He was formerly at Midland, Texas.

▸ **Lewis E. Young,** president of the American Institute of Mining and Metallurgical Engineers, was the guest of honor at a dinner meeting at the AIME Permian Basin Section recently in Midland, Texas, it has been announced by Thomas C. Frick, The Atlantic Refining Company, Midland, chairman of the section.

Young, who is a Pittsburgh, Pennsylvania, consulting engineer and an international authority on mechanical mining methods, was also guest of honor at a reception, prior to the meeting, sponsored by Dowell Incorporated. He was taken on tour of the area's oil fields. His address to the section at the evening meeting was on "Technical Assistance to the ECA Program."

Young has engineered mining installations in the U. S., Canada, British Isles, Europe and South America, principally in the coal industry and has devoted recent years to coal mining safety research.

▸ **James N. Wilson,** engineer with Seismograph Service Corp., has been transferred from Erie, Colorado, to Kermit, Texas.

▸ **R. S. Mann** has been named district geologist with the exploration staff of Shell Oil Company of Canada, Ltd. Since November, 1946, Mann has been district geologist in the San Antonio-Corpus Christi, Texas, district.

H. H. Lester will succeed Mann as district geologist in Corpus Christi. Lester is a graduate of the University of Colorado, and was formerly assigned to San Antonio as subsurface geologist. He went to Corpus Christi from Tyler, Texas, where he was assistant district geologist.

▸ **J. Frank Shinkle,** landman with Superior Oil, has been transferred from Evansville, Indiana, to Midland, Texas.

▸ **F. C. Sealey** has been elected a vice president of The Bahrein Petroleum Company Limited, in charge of producing and exploration, with offices in New York. He is also executive vice president of American Overseas Petroleum Company.

Sealey entered the oil industry 32 years ago as an assistant geologist, and for the past 11 years has been associated with foreign producing activities. He was born in Denver, Colorado, and graduated from Colorado School of Mines, Golden, Colorado, in 1917, with the degree of Engineer of Mines, and took special work in petroleum geology.

▸ **E. V. Watts** has been appointed production superintendent of the southern division of General Petroleum Corporation's Production Department, it was announced by R. O. Swayze, manager, California operations.

E. V. Watts

Watts has been assistant to C. C. Gandaubert, southern division superintendent, and, in his new post, will continue to report to him.

Watts is a graduate of the California Institute of Technology, and joined the General Petroleum Corporation in 1936. His first position was as a roustabout in the Lost Hills field. Within a year he had advanced to engineer at the company's Vernon headquarters.

Watts is active in industry activities, having served as chairman of the Pacific Coast district of the American Petroleum Institute, Division of Production, in 1947-48. He is a member of the Conservation Committee of California Oil Producers, the American Institute of Mechanical Engineers, and Tau Beta Pi.

▸ **Captain V. H. Wilhelm,** U. S. Naval Reserve, died July 7 in the U. S. Naval hospital, Long Beach, California. Wilhelm was former chief petroleum engineer of The Texas Company until ordered to active duty by the Navy. He was selected by the Navy as inspector of Naval Petroleum Reserves in California, and contributed outstanding service to the oil industry in connection with the engineering studies that determined the participating percentages of the Navy and the Standard Oil Company of California in the Elk Hills of California.

▸ **K. A. Robertson,** area supervisor of Canadian and Rocky Mountain activities of United Geophysical Company of Tulsa, Oklahoma has been appointed vice president of United Geophysical Company of Canada, and will make his headquarters in Calgary. Wayne A. Phares has been appointed area supervisor for gravity operations in the area.

▸ **W. A. (Tex) Thornton,** famed oil field explosive expert, was found slain in an Amarillo, Texas motel June 22. A young man and woman whom authorities believe have some connection with the murder are being sought, however, no definite arrests have been made to date.

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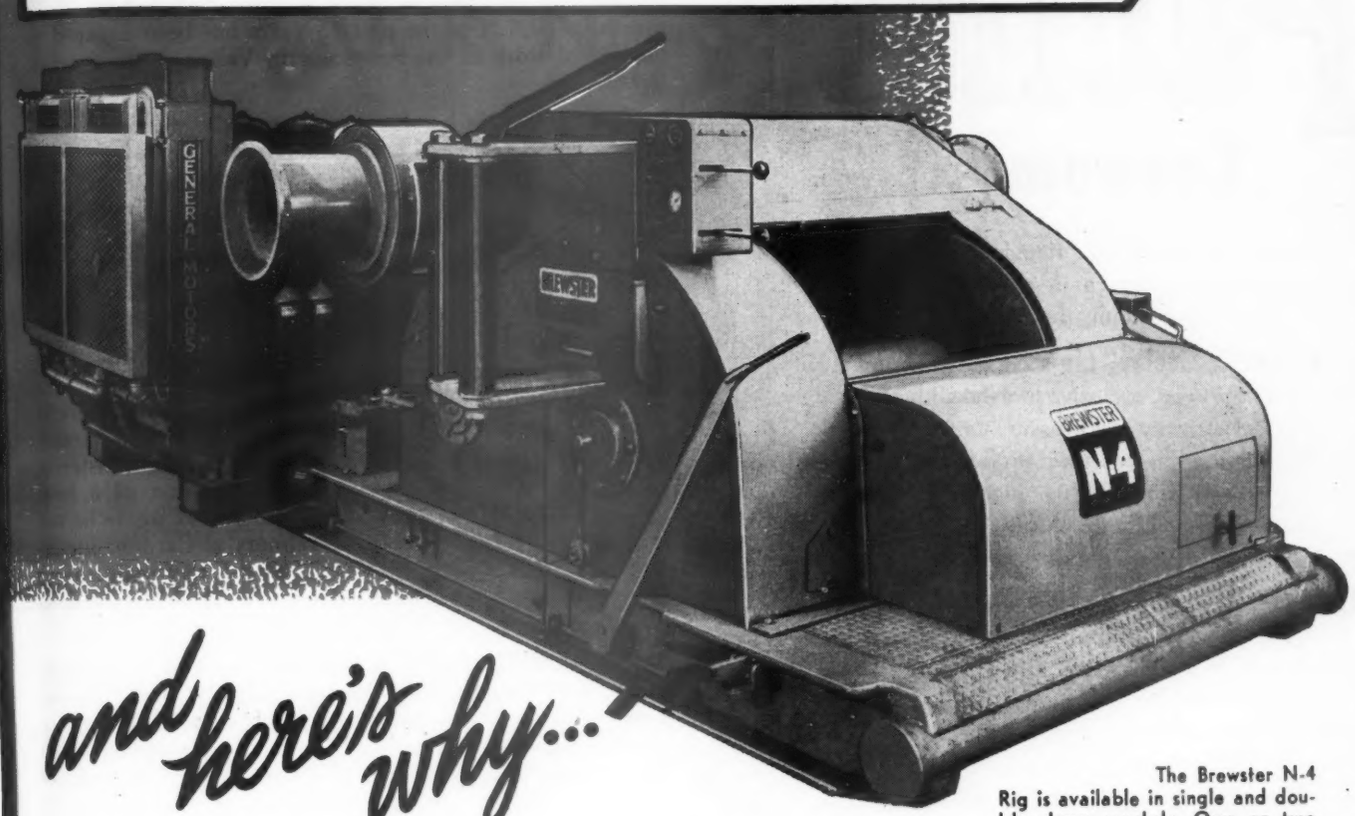

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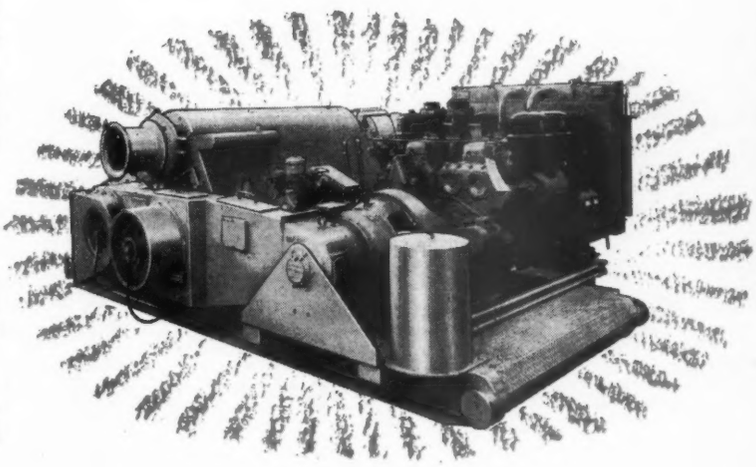
The Brewster N-4 Rig is available in single and double drum models. One or two engines.



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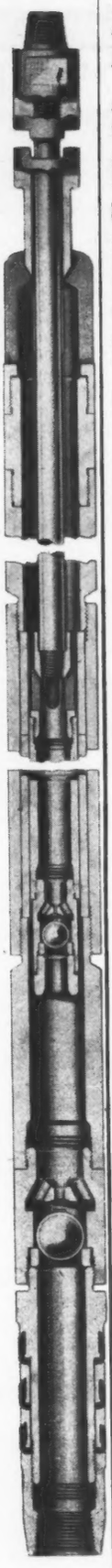

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▸ **Roy E. Darke,** geologist with Standard Oil Company of California for the past 30 years, retired from the company on July 1. A graduate of University of California in 1910, Darke engaged in mining for five years, then worked as a petroleum geologist for four years in Oklahoma before joining Standard of California.

During his first eight years with the company he saw service as a geologist in South America, returning to California in 1927. For the past 15 years has been engaged in geological work in the San Joaquin Valley, with offices at Bakersfield.

▸ **W. H. Loomis** has been made superintendent, Ventura district, at Santa Paula, California, by The Texas Company. **R. L. Jackson** was made superintendent, Los Angeles basin district, at Signal Hill. This is an exchange of positions. **T. R. Beauchamp** has been appointed assistant superintendent of Los Angeles Basin for production, gasoline and drilling operations.

▸ **J. P. Jurrius,** former first assistant chief engineer for CPIM (N. V. Curachaosche Petroleum Industrie Maatschappij) has been promoted to chief engineer. Having entered the employment of the Bataafsche Petroleum (Shell) Maatschappij at The Hague in 1921, he was sent to Mexico where he remained until 1925, at which time he transferred to Maracaibo, Venezuela. With the exception of a brief period from December, 1946 to August, 1947 where he was in charge of construction of the refinery at Cardon, Jurrius has been at Curacao since 1935, first as chief maintenance department, and subsequently as first assistant to the chief engineer.

▸ **Gordon W. Heid** has been transferred back to Houston, Texas, in the area exploration department of Shell Oil Company. He will be area geologist, and is former eastern district geologist at Midland. Gordon has been employed with Shell since 1937, after eight year's experience as geologist in the East Indies.

▸ **E. H. Leeman,** exploitation engineer, regional production, has been appointed representative for the East of the Rockies territory for Shell Oil Company, to train for six months with the Bataafsche Petroleum Maatschappij, The Hague, Holland. Leeman's appointment is the first one made for training in a foreign office since this phase of Shell's training program was temporarily stopped during the war. Before the war training in the company's foreign office was a part of the regular training schedule. While in The Hague, Leeman will observe general engineering practices with the production department.

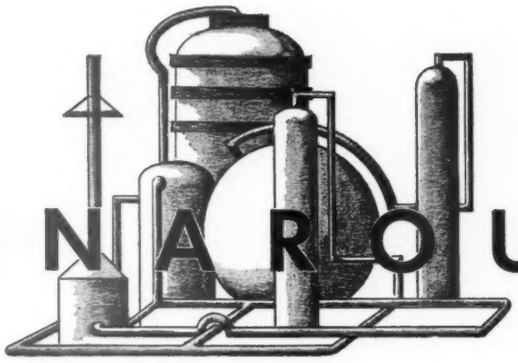
▸ **F. C. Sealey** has been elected a vice president of The Bahrein Petroleum Company Limited, in charge of producing and exploration, with offices in New York. He is also executive vice president of American Overseas Petroleum Company.

He entered the oil industry 32 years ago as an assistant geologist, and for the past 11 years has been associated with foreign producing activities. He is a graduate of the Colorado School of Mines.

▸ **Harold Richard Delaney,** partner in the M. J. Delaney Company, prominent oilwell drilling contractor, and in the D.K.M. Company, died suddenly at his home July 1. Son of the late Michael J. Delaney, founder of the drilling firm bearing his name, Delaney came to Texas 28 years ago from Tulsa, Oklahoma. He was graduated from Notre Dame University in 1915, with a law degree.

He was a director in the American Association of Oilwell Drilling Contractors; a member of the American Petroleum Institute, the Mid-Continent Oil and Gas Association, the IPAA, the Dallas Petroleum Club, the Midland Petroleum Club, and The Tulsa Club.

THE TURNAROUND



Penalty for Progress

THIS generation of human beings has not seen at any time the equal of the epoch-making miracle of synthetic rubber manufacture. When our natural rubber supplies were cut off after Pearl Harbor, this country stood defeated already at arms, in the opinion of most of the civilized world. Synthetic rubber had never been a success except in infinitesimal amounts of specialty non-tire rubbers. Concerted efforts by private industry to boost research and development of synthetic rubber technology had been squelched by a short-sighted government, which immediately afterwards was forced to call in those same units of industry, dump the apparently insuperable problem in their collective laps and beg for a solution.

Long-headed cooperation between rubber and petroleum industries' scientists and technologists solved the problem, after months of ceaseless work. Estimates, "guestimates" and test-tube-to-100,000-ton-plant long shots finally showed the way to butadiene from petroleum hydrocarbons. Combination of the efforts of the alcohol, coal-tar, and petroleum industries produced styrene by what appeared to the outsider to be Alladin's-lamp procedures. Butene from catalytic cracking process was dehydrogenated further catalytically to form the peculiar diolefin, butadiene. Ethylene was made by cracking propane-ethane hydrocarbons to combine with benzene to make ethylbenzene, then dehydrogenated catalytically to phenylethylene or styrene. These two unstable products were polymerized to produce rubber-like materials usable for tires and other indispensable purposes. The multitudinous problems relating to modifiers, plasticizers, softeners, and the other auxiliary, but important ingredients of finished rubber, required tens of thousands of man-hours of work to make possible a satisfactory product, but the work was done and the product is here.

The result is an everlasting tribute to applied science and technology. The American motoring public, which includes the huge majority of Americans, will be saved $360,000,000 during 1949 by lower rubber prices. The price of rubber is said to be 30 cents lower than natural rubber prices would be if the synthetic product were not available to stabilize these prices; 300,000 tons of rubber will be synthesized this year.

The net result appears to be a demand for another tax on industry and heads-up enterprise. Some are calling for a rebate to the government because of this paper saving in the form of a rubber tax. Such a development will further penalize the greatest technology that the world has ever known. The country all over has already enjoyed the potential saving, and should be allowed to profit by it without further penalty.

—A. L. F.

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UOP

American Liberty Adds 10% to Gasoline Yield

By A. C. Johnson

Assistant Superintendent
American Liberty Oil Company
Mount Pleasant Refinery

AN INCREASE of about 10 percent in the overall gasoline production of our Mount Pleasant refinery has been realized without running additional crude by the installation of a non-selective catalytic polymerization plant. This unit utilizes UOP solid phosphoric acid polymerization catalyst for converting the propylenes and butylenes in the total cracking plant gas to hydrocarbons boiling in the gasoline range.

A. C. Johnson

A poly plant was first planned in 1941, but consideration was dropped during the war when practically all of our output was directed to the manufacture of fire bombs.

Because of vastly improved markets and the need for higher octane numbers, the project was revived in 1946 and Universal Oil Products Co. was asked to make a survey. As a result, UOP was called upon for all design and processing work, while American Liberty engineers conducted all architectural and layout work with UOP acting as consultant. All new vessels except the catalyst case and deethanizer tower were fabricated by the refinery with existing equipment being used wherever possible.

Design Capacity 2,160,000 cu. ft.

The design capacity of the poly unit is 2,160,000 cu. ft. of fresh cracked gas per day representing the total gas produced by the UOP thermal cracker. The quantity of polymer gasoline produced depends upon the amount of gas available for processing, and this in turn, depends upon the operating schedule of the cracking plant. At design capacity, the poly unit will produce 235 b/d of 10 pound polymer gasoline. During the past year, however, it has been advisable to operate the cracking plant for maximum throughput of gas oil rather than for maximum yield which has limited the poly yield to an average of 170 b/d.

Shut down on April 4 of this year, after its first run of 195 days actual on stream time, the poly unit showed a total output of 1,263,765 gal. or 81 gal. per pound of catalyst.

The polymer gasoline produced has a clear Motor Method and a clear Research Method octane number of 82.5 and 97 respectively with blending values substantially higher. The high octane blending value, both motor and research, makes this product very valu-

(Advertisement)

able in raising the overall level of the refinery's gasoline. By blending with cracked gasoline and selected straight run materials, the octane rating of premium gasoline can be raised two octane numbers, or a given octane reached with approximately half the lead formerly required.

Gas from the cracking plant absorber is compressed in the low stage of the compressor, and together with the high pressure gas from the cracking plant stabilizer, is sent to the treating section operating at 150 psi. Having about 1,200 grains of H_2S per 100 cu. ft. and fairly high mercaptan content, the gas first enters the Girbitol unit where H_2S is removed down to 25 grains. In the H_2S scrubber the last traces are removed by caustic. Mercaptans are extracted in a regenerative caustic system.

The sweet gases are then compressed in the high stage to 500 psi, and heated to 380° F. by first exchanging heat with catalyst tower effluent and then through a heater using hot oil from the cracking unit as a heating medium. The hot gas enters the top of the catalyst chamber where contact is made with the catalyst, which is arranged in five beds with a total charge of 15,000 pounds. Proper hydration of the catalyst is controlled by the addition of water and the reaction temperature of each bed is controlled by using liquid propane as a quench.

Operating Data

Operating data for the catalyst tower is as follows:

Pressure, psi	450
Temperature, Gas in, °F.	380
Temperature, 1st Bed, °F.	410
Temperature, 2nd Bed, °F.	420
Temperature, 3rd Bed, °F.	425
Temperature, 4th Bed, °F.	430
Temperature, 5th Bed, °F.	435

After the polymerizing action of the catalyst, the effluent from the catalyst chamber is cooled and gas is removed from top of the catalyst tower effluent receiver. This gas goes to the poly absorber where recoverable light ends are picked up and returned to the cracking plant fractionator. The liquid from the receiver is then charged to the deethanizer.

With adequate cooling and subsequent low deethanizer receiver temperature, maximum propane recovery is possible. A small amount of propane, together with the ethane and lighter gases, is taken overhead to fuel, and bottoms are charged to the depropanizer. The depropanizer, operating at 275 psi produces specification propane overhead, the bottom being charged to the debutanizer. From the bottom of this vessel poly gasoline at specified Reid vapor pressure is removed with all excess butane going overhead to storage.

Today the American Liberty Mount Pleasant Refinery has a crude capacity of 13,000 barrels, thermal cracking capacity of 4,000 barrels, and facilities for the manufacture of asphalt and special naphthas, as well as the new poly unit.

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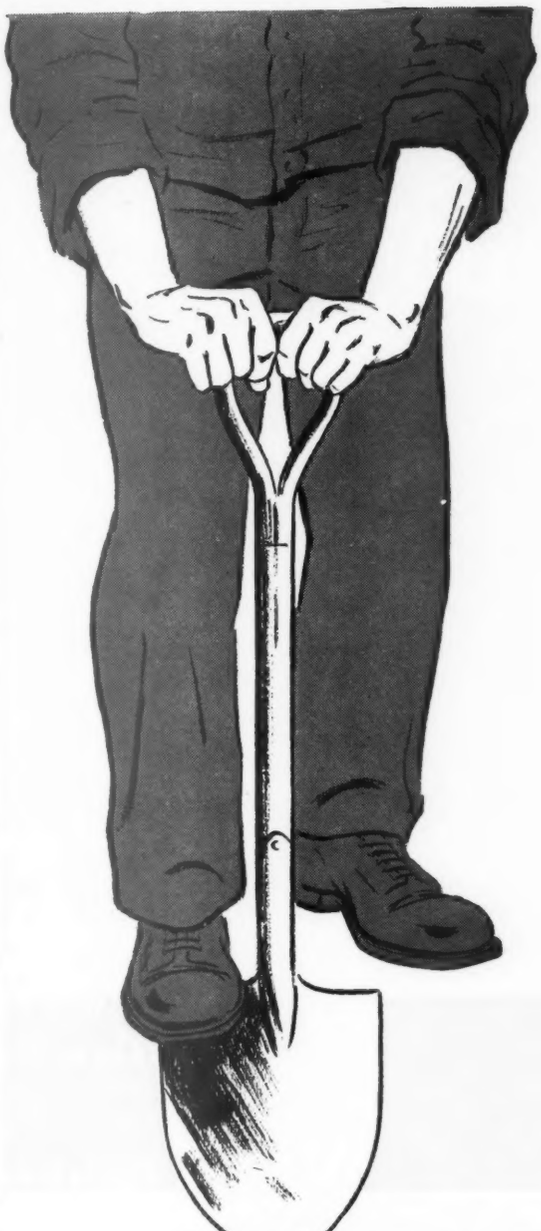

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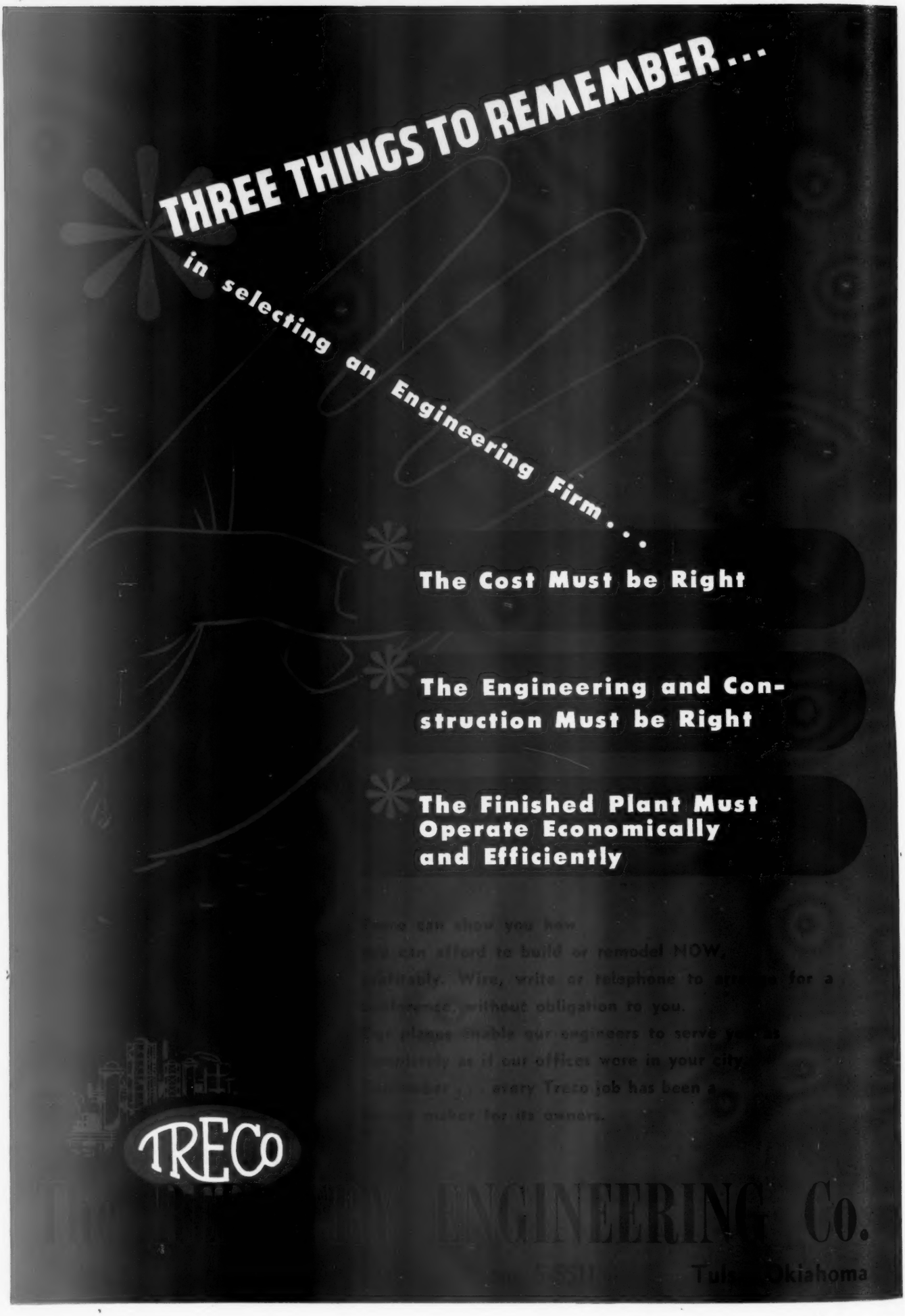
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in selecting an Engineering Firm...
The Cost Must be Right
The Engineering and Construction Must be Right
The Finished Plant Must Operate Economically and Efficiently
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FIG. 1. Powder-cutting and scarfing apparatus.

FIG. 2. Welding Hexteel in large diameter line.

The Turnaround As an Efficient Routine

ARCH L. FOSTER*

THE turnaround, or inspection-replacement-repair routine in a modern refinery, has become one of the most meticuously systematized operations in the refinery. The concentrated intensity of the cat cracker turnaround is justified by one consideration, the extremely high expense of having so costly, and so revenue-productive a unit off stream. Because of severe operating conditions, failure of modern materials to meet demands made on them, and because our total experience in catalytic cracking and other process operations is inadequate as yet to form a perfect guide to the how, what, and when of repair and replacement programs, a study of the routines, findings, and methods for turnarounds of other companies may add to our knowledge and aid in improvement of the detail of this operation.

In this article various methods, routines, and findings by the maintenance department of Humble Oil and Refining Company in inspecting, repairing and maintaining fluid catalytic cracking units are described. It must be remembered that in most of the items discussed here, earlier efforts and actions were in the nature of exploratory plunges into the entirely unknown. Earlier experiences as guides to what to expect and what to do were in most cases non-existent or so inadequate and inconclusive as to be either valueless or actually misleading in some instances in preparing for later turnarounds.

Much of the efficiency of a turnaround is determined by the thoroughness with which preplanning of the routines is carried out. Normally, turnarounds will require from a few days to two or three weeks' time, and will include the part- or full-time work of hundreds of men. A typical turnaround at Baytown late in 1947, which included a great deal of major overhaul and replacement-repair work, extended from October 24 to November 9, a total of 16 days elapsed time, and more than 62,000 man-hours, including shop-work time. The largest number of men on duty at one time was 501, with nearly 4000 man-hours put in on one day. Obviously a smaller unit, or one that required less repair work, would require a smaller number of man-hours and a smaller force. A later turnaround on this same unit was completed in 15 days elapsed time.

Preplanning for the turnaround referred to in 1947 was an involved procedure. Originally the turnaround was scheduled for September, so a preliminary meeting of all interested directive personnel was called by the turnaround supervisor in July. This

*Refining Editor

EXCLUSIVE

TABLE 1. Typical mechanical job schedule for catalytic unit turnaround.

Job Description and Location	Craft	Shift	Day of Turnaround																Man-hours total
			−2	−1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Total all crafts, incl. shop work	Pipe	2	533	1805	1144	866	789	908	840	885	697	723	848	913	770	693	786	843	
	Carp.	2	58	306	245	255	229	263	226	241	225	153	170	204	144	189	198	158	
	Blacksmiths	2				11	5		23			25		15					
	Rig.	2	88	268	468	473	430	472	576	433	480	434	569	453	502	430	342	152	
	Recla.	2	4		32	162	218	159	261	196	191	42	59	46	59	71	210	34	
	M'chine	2	16	24	225	423	597	827	831	530	358	558	881	495	448	225	53	64	
	Insul.	2	32	32	41	49	101	127	85	26	48	114	111	149	138	134	136	144	
	Electric	2	32	16	92	64	84	93	95	92	96	90	117	108	84	84	84	70	
	B-make.	2	32	224	441	662	909	834	909	1145	1060	779	1044	1188	1064	713	839	231	
	Instur.	2	48	40	185	192	272	156	230	94	48	97	67	170	109	91	46	66	
	Labor	2	168	472	672	595	559	551	482	380	323	234	383	319	462	417	537	226	
	Tool & Equipt.	2			24	47	31	32	34	42	26	18	12	24	16	16	18	24	
	Tin.	2			59	24	62	28	40	24	32	26		12	30	23		10	
	Weld.	2		28	169	286	286	373	303	478	441	452	412	385	508	376	762	70	
	Brickmasons	2				24	24	50	40	24	40	48	88	24	80	68	70	5	
	Painters	2							19			28	36						
	Daily total		1011	2815	3757	4133	4596	4891	4994	4600	4065	3920	5714	4451	4414	3530	3051	2097	62,039

meeting included representatives from the departments of inspection, mechanical, maintenance engineering, engineering, technical service, and process. Later the turnaround was postponed until November. Part of this meeting included submission of all work lists as estimated and arranged by the different services. All items were discussed and after that a preliminary work list for the job was made up, as a guide to preplanning the turnaround. To simplify the planning and routine, a three-weeks' deadline before the shutdown was set, for inclusion of major items of work by all departments with the one exception of inspection.

Several weeks before the shutdown date the turnaround supervisor spent five days with all major craft supervisors going over the work list and in study of all items therein. As a part of the work of these meetings the staff entered on a "master planning sheet" daily estimates of work (manpower) for each craft for each job on each day. The turnaround supervisor then adjusted the manpower shown on this sheet (Table 1) in order to average out daily craft totals. The next step included supplying individual job-planing sheets to each craft supervisor on which each separate job was planned. On the day the unit was shut down a meeting was held in which all craft supervisors, the material handler, and all turnaround supervisors reviewed the work list and the planning sheets.

A large number of things were completed prior to the unit's shutdown. Whenever possible outside scaffolds were erected, where plans showed that work was to be done requiring such scaffolds. These scaffolds include both fixed and portable types, for example, scaffolds are erected before shut down where all safety valves are to be inspected and reconditioned. Variable orifices to be removed from catalyst lines to inspect and repair or replace require scaffolds, which also are built beforehand. For all scaffolding required, the lumber is brought to the spot, ready for erection either before or after shutdown. Sometimes as much as two or three railroad carloads of lumber are requisitioned for one turnaround and all this must be foretold, planned for, and made available before the turnaround begins. Scaffolds for replacing the numerous expansion joints are built before shutdown, as are those for inspection and repair of heat exchangers, except where portable platforms may be used and put into place beforehand, unless their presence interferes with something to be carried out earlier. Scaffolds are erected in advance for the removal of manheads from drums, vessels, etc., also in those locations where gaskets must be replaced.

Scaffolds for locations inside the unit must be put in after shutdown. These include the scaffolding for inspection of vertical "runs" of catalyst and vapor lines. A catalyst line may be broken at a prearranged point, as the eleventh floor of the structure, as soon as the unit has cooled sufficiently, and scaffolding built into the inside of the 6-ft or greater diam line to permit workmen to install wear plates, liners, etc., in that line.

Prearranged or prognosticated welding to be done indicates the number of welding units needed and their locations, and these are brought in before shutdown and placed at the required levels ready for use. Other equipment such as winches, hoists, even cranes, and other equipment needed by the riggers is brought in and located whenever possible to do so without interfering with other matters. Much of the replacement material is fabricated in the plant shops, where it is prefabricated, and placed on location, ready for use before shutdown. Every step possible is taken to speed up the job and to reduce both elapsed downtime and manhours of work required to the minimum.

The supervisory personnel required for this typical turnaround includes the following:

The turnaround supervisor, who handles all mechanical work for the entire job.

Assistant turnaround supervisor, who handles furnace and fractionation section work and assists the supervisor.

Turnaround coordinator, who maintains turnaround records, operates the Produc-trol board, and revises and distributes work lists.

Material handler, who orders and receives all material from the storehouse, also supervises the communications system.

4-12—Shift supervisor. Rigger supervisor.

12-8—Shift supervisor. Instrument supervisor.

Pipe—Shift supervisor. Insulation supervisor.

Boilermaker—Shift supervisor. Labor supervisor.

Machinist—Shift supervior.

Whenever necessary, supervisors for brickmasons, electrical equipment workers, reclamation work, and sheet metal work are supplied by those departments. A list of supervisors and their duties is posted at the mobile tool room, in the control room, and at drinking fountains for the information of all concerned in the work. Supervisors meet twice daily at 9:15 a.m. and at 2:00 p.m., and after the morning meeting a progress report is made over the public address system for the information of the staff.

To give an instant picture of the work and the status of each item, a Produc-trol board is set up before the turnaround is begun. Daily manpower estimates for the various crafts are indicated by white and colored pegs

FIG. 3. Brickmasons plastering castable over Hexteel.

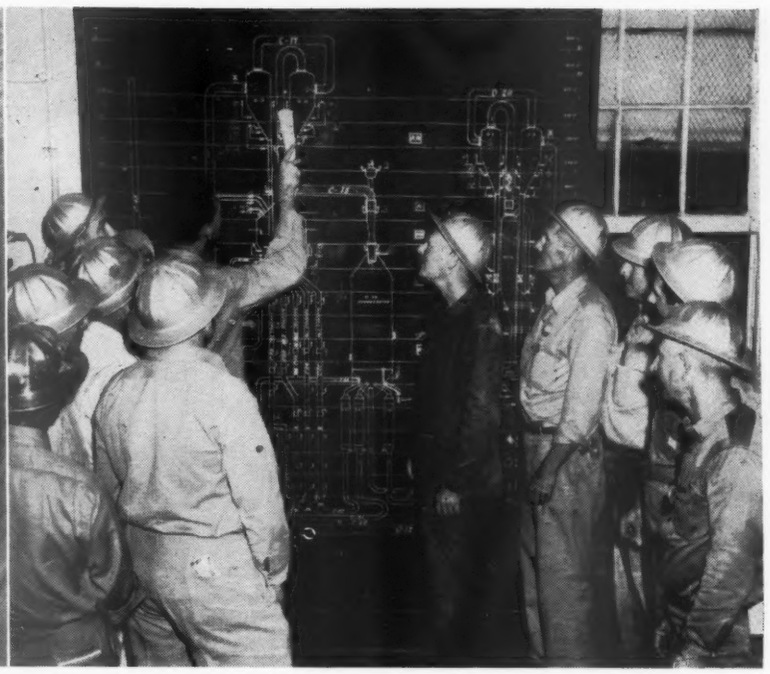


FIG. 4. Supervisors' meeting at unit diagram.

pushed into holes in the board, each work item being assigned a number. Each day the coordinator moves the current day's "string" to correspond to the actual day of the turnaround, and removes all strings on jobs completed. Any strings remaining on the board behind the current day's string show a job that is behind schedule. For the typical turnaround referred to report states that 16 man-hours were required to set up the plan of the job on the board.

Previous experience has shown clearly that a great deal of time is consumed in obtaining tools from the regular tool room and in returning them after use. A mobile tool room has been provided, stocked with the entire list of tools and small equipment items normally required for the job. This room, 8 ft x 35 ft, is transferred to the unit and remains there during the turnaround period. A pickup truck is kept at the room for the purpose of going after and bringing tools and equipment that may be called for unexpectedly. During the day two men, a tool dispenser and a materials handler, are kept on duty at this toolroom, and one man is on duty from 6:00 p.m. to midnight. The mobile toolroom stays open from 7:30 a.m. to midnight, and the night man operates the public address system at the unit. This address system has been found to be invaluable as a time-saver and to coordinate the work. At stated intervals short addresses are made by various executives, discussing the status of the work, receipt of equipment or material is announced, and men are called to the phone or to a given rendezvous when needed. Loudspeakers are placed at various places and levels to serve the entire staff. The unit consists of three 50-watt amplifiers, microphone in the toolroom, and 16 loudspeakers.

FIG. 5. Removing tubes from primary spent catalyst cyclone.

Suggestions and Practices

One of the major discrepancies in earlier planning efforts resulted from relatively brief experience in judging the work that would be necessary to do in a given turnaround, and the time and manpower required for it. Necessarily no inspection of the interior equipment of the unit can be made, in most cases, prior to shutdown, consequently the exact condition of the various items cannot be exactly determined beforehand. Careful records are kept of the condition of all parts of the unit, for each turnaround, and these records are referred to in detail in making estimates of the

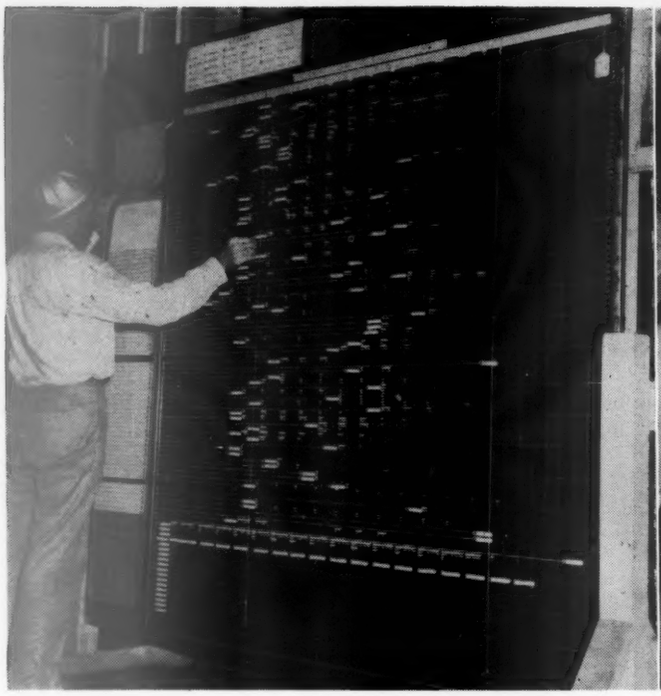


FIG. 6. Turnaround coordinator at "Produc-trol" Board.

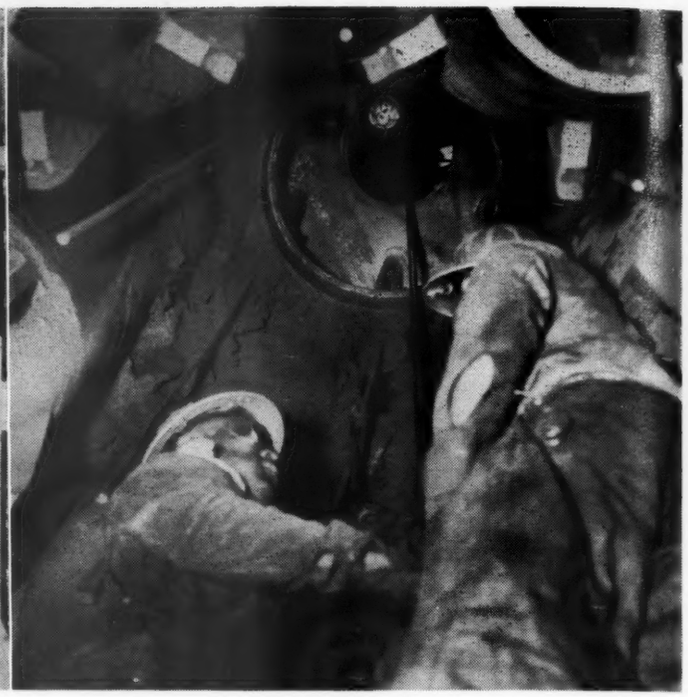


FIG. 7. Cleaning coke from D-7A cyclone tubes.

work that probably will need to be done on the next turnaround. For example, quoting from one report, "Examination of the firebrick indicated that several were loose, and erosive gouges were noted at a number of locations. However, no repairs were felt to be necessary at this time." For the next turnaround, the supervisor would doubtless plan for careful inspection of this firebrick protection, and probable replacement of the entire installation of firebrick.

Experience has shown that as more data are obtained regarding the service life of material in various positions, closer estimates of manpower, man-hours, and replacement material required can be made. Details of experiences with many different problems will be given in the latter part of this article. In planning work, experience has shown that the use of a Produc-trol board is advantageous. The mobile toolroom showed a saving of 1050 man-hours on one turnaround. The public address system is considered very useful also, as it locates and informs men quickly, and relieves the load on the cracking unit elevators, always a bottleneck during these times. Better roads to and from the unit, to bring in supplies, material, etc., are important, and in one report a "large, paved, material-handling slab" is recommended by the supervisor. Other items and practices recommended include skip-stop operation of elevators, to speed their work, installation of more cranes to handle equipment more expeditiously, arrangements to use "bulk oxygen for burning operations," that is, central storage of oxygen with piping to conduct oxygen to the location where used. Eliminating cylinders, and many other improvements in technique have been worked out and adopted.

One outstanding development that speeded up work, reduced cost, hastened the date for on-stream, and cleared the way for other work is that of using a relatively new "Powder Cutting and Scarfing Apparatus." This method for cutting especially large alloy lines such as stainless and other hard, tough steels saved a great deal of time and work. Much faster than chipping, the method made eight cuts, totaling more than 100 ft in length in about 7 hr. To chip these lines as was done earlier on similar jobs would have required more than 100 hr, and at least one additional day would have been needed for the turnaround had this cutting method not been used. On this one setup 185 man-hours were saved, the reporting official estimated.

Repairs and Replacements

The number of details of repairs, replacements, or items to be changed reaches astronomical figures, especially when considering extenive experience with a large number of turnarounds. However, it is enlightening to study the routines of these inspections and repairs, and to find what experience has taught regarding the choice of materials to meet the requirements under conditions with which little if any experience existed prior to operation of these units. For example: In repairing cyclones, vanes and tubes were found to suffer extensive damage in some locations. A primary spent (catalyst) cyclone (D7A in Fig. 14), the tubes of which had been in service 170 days, showed only mild erosion in the top positions. Vanes were also mildly eroded, and both were reclaimed by "cleaning up." All were of 18-8 chrome-nickel steel, and the lower tubes and vanes were seriously eroded, but were repaired by welding and grinding. The seven lower vane and tube sets were replaced by new tubes and (shrouded) vanes of Ni-Resist No. 3 material; these items are cast metal. The lower tube sheet in this cyclone was seriously eroded; however, it was repaired by welding with 25-20 Cr-Ni metal and grinding smooth, the same being done for the underside of the upper tube sheet. The inlet distributor angle was eroded severely and was replaced with a new one made of KA2S alloy. In a second spent (catalyst) cyclone, tubes and double-shrouded vanes were made of Ni-Resist No. 2 protected by impingement erosion protectors of 9/32-in KA2S alloy and carbon steel plates, which had taken care of the tubes from incoming catalyst but were themselves sadly eroded. Most of the vanes and the lower tubes were eroded seriously, with holes through the metal

FIG. 8. Stress-relieving weld in C-23 line.

FIG. 9. Upper tubes, third reactor cyclone (D-9), holes from impingement, etc.

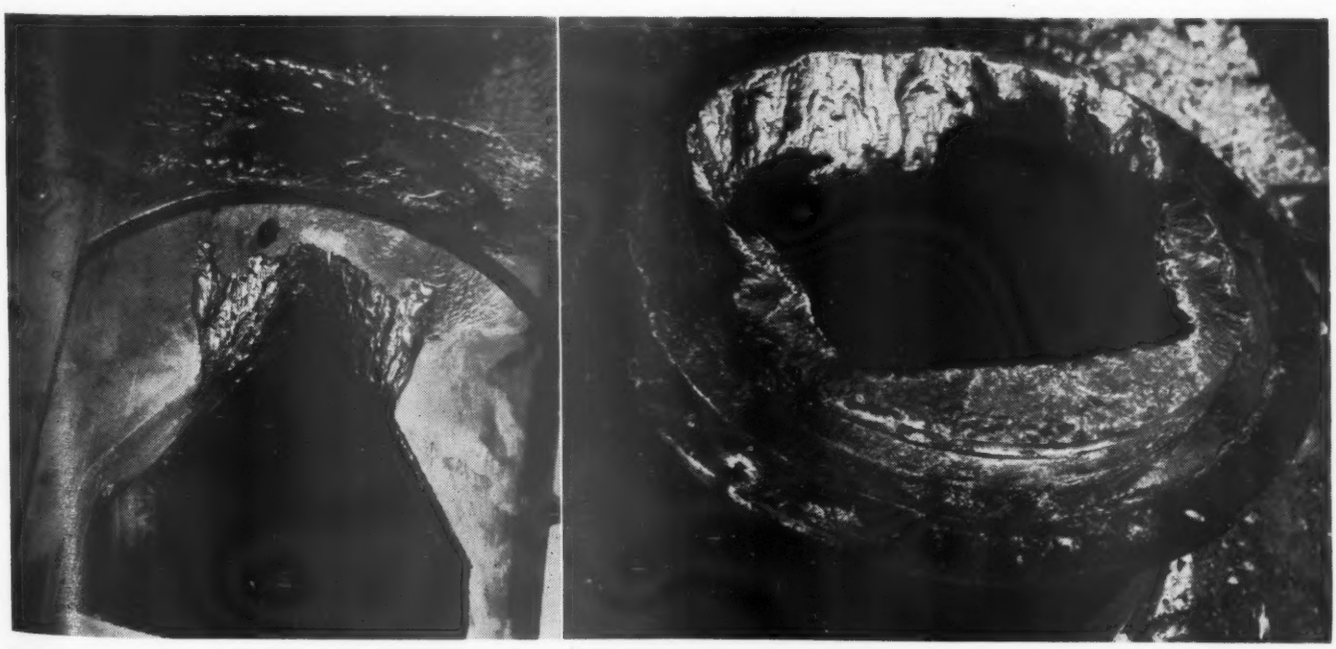
in many places. All were replaced with 18-8 Cr-Ni alloy tubes and vanes. Typical of these operations is the notation by the inspector that the lower tube sheet was repaired by welding but that evidently it must be replaced at the next turnaround. This warning will have been considered when plans are being assembled for the next inspection and proper prearrangement will have been made for the replacement.

The third cyclone (D9) being last in the line showed the least erosion and damage and little repair was needed. Tube gaskets were repaired with Smooth-On No. 2, and an inlet splash pan was replaced. In another inspection-turnaround, upper cyclone tubes were found to have been protected fully by a "180° coat of Hexteel and castable." This covering is made up of hexagonal gridwork of steel; the hex pockets filled with concrete or equivalent. It is used widely for protective purposes, such as wear plates, replacing stainless alloy and carbon steel plates employed earlier. Badly eroded lower tubes were replaced with tubes of 18-8 Cr-Ni or of Ni-Resist, protected with this same "Hexteel and castable" combination. Even this coating suffers considerable erosion in certain locations, such as the shell, covered "between the tube sheets" in cyclones, and is required to be replaced occasionally. In the first reactor cyclone (D7A) carbon Hexteel is being replaced with alloy Hexteel, as the carbon steel causes the alloy steel, to which it is attached, to crack.

In another cyclone in which all tubes were eroded severely, after service from October to the following July, 18-8 Cr-Ni was used for replacement, and all but two were covered with "⅝-in. floorsteel and castable."

FIG. 10. Erosion of port opening, etc., on catalyst recycle standpipe slide valve.

FIG. 11. Erosion of port opening, 8½ x 8½-in., slide valve in spent catalyst standpipe.



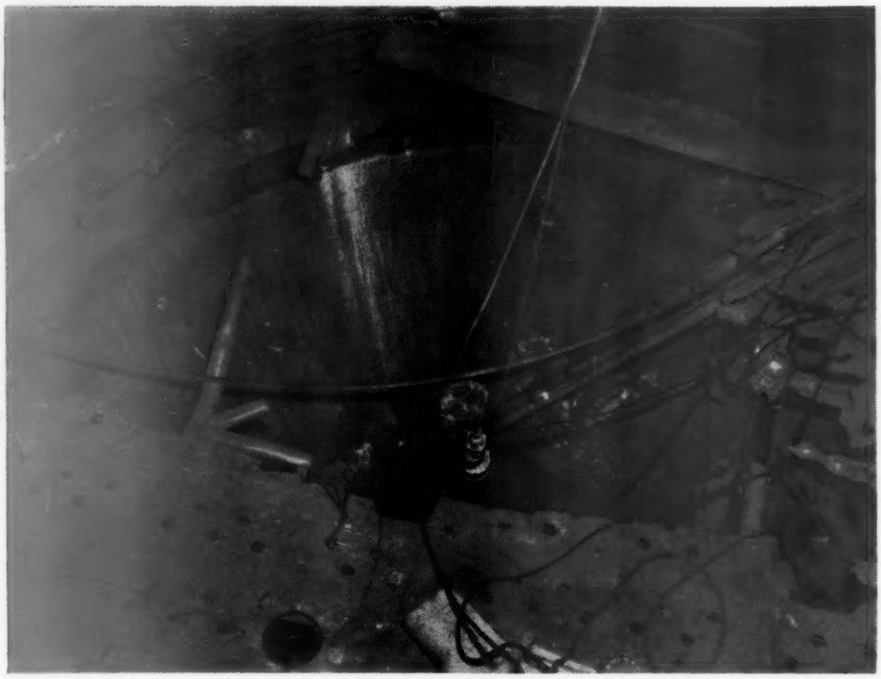


FIG. 12. Regenerator grid damages.

These two were covered by the same floorsteel filled with a special cement for test purposes. Gasket leaks allowed erosion of tube holes, which were welded and ground to size. In some regenerator cyclones, castiron tubes and vanes showed severe erosion, and were replaced by new castiron units. Tube sheets in regenerator cyclones showed severe erosion requiring welding, and double-shroud vanes have shown less efficiency in reducing erosion than the older single shroud type. Spent-catalyst cyclones show severe erosion, and half-round and flat protector plates wear entirely through between turnarounds. However, cast 18-8 tubes and vanes, ASTM Spec. 157-44, lasted for two years, showing severe erosion at the end of that period, in a third spent catalyst cyclone. This is four times the length of service obtained from any other alloy, and the operators indicate that this type of cast unit is to be relied on in the future, also that the more efficient single-shroud vane is to be used in primary and secondary cyclones to remove more of the catalyst load.

In some cases the earlier-installed carbon or other steel wear plates have been replaced with Hexteel and castable or with castable refractory layers, as in cyclone dip legs. In repairing cracks and in filling holes in units 25-20 Cr-Ni weld rod is used frequently. The 18-8 alloy 50-in. line from the reactor to the cyclones is being replaced by carbon steel.

Reactors and Regenerators

Inspection of the interiors of reactors indicates a "polishing" type of erosion takes place there. It becomes more severe along the longitudinal as well as the circumferential weld seams, and it is believed that after erosion at these locations is well started, the rate will increase due to the surface condition produced. A firebrick lining, replacing a tile lining, in a regenerator (D-10), showed excellent erosion resistence, including the special wash coating over the face of the bricks, which, though cracked, resisted erosion almost completely. Because wear at weld lines in reactors continued to be severe, plans were mentioned by the inspectors to install some type of protective liner to eliminate this difficulty. A monolithic, fireclay base material is to be installed in regenerators, having shown good results in service.

To protect the center beams supporting the grid plate in a regenerator, and to prevent erosion, Hexteel reinforced castable was installed below the flanges on these beams. An interesting occurrence was that of a recycle cooler leaking, which caused had burning in the regenerator, burning away completely some 20 per cent of the grid, as well as some of the steel liner in the lower cone. Firebrick protecting both shell and lower cone had not disintegrated appreciably and had given full protection during the extraordinary conditions of operation. The Hexteel-castable coating, as used, for example, in these various locations has proved to be superior to metal wear plates. In the same catalyst hopper, metal wear plates had broken completely loose on one occasion, and it was necessary to replace them. The Hexteel-reinforced castable unit was in place and no repairs were necessary, although the excess temperature, probably more than 1800 F, had blistered the 4-6 Cr-½-Moly steel outlet line below the castable protector's lower edge.

Exchangers and Coolers

During one inspection-turnaround a recycle catalyst cooler (E-8) a tubular exchanger type of unit, was found to show very mild erosive conditions, except where a hole had been worn in one tube in which a small piece of metal was lodged. This tube was

FIG. 13. Damage to support for regenerator grid.

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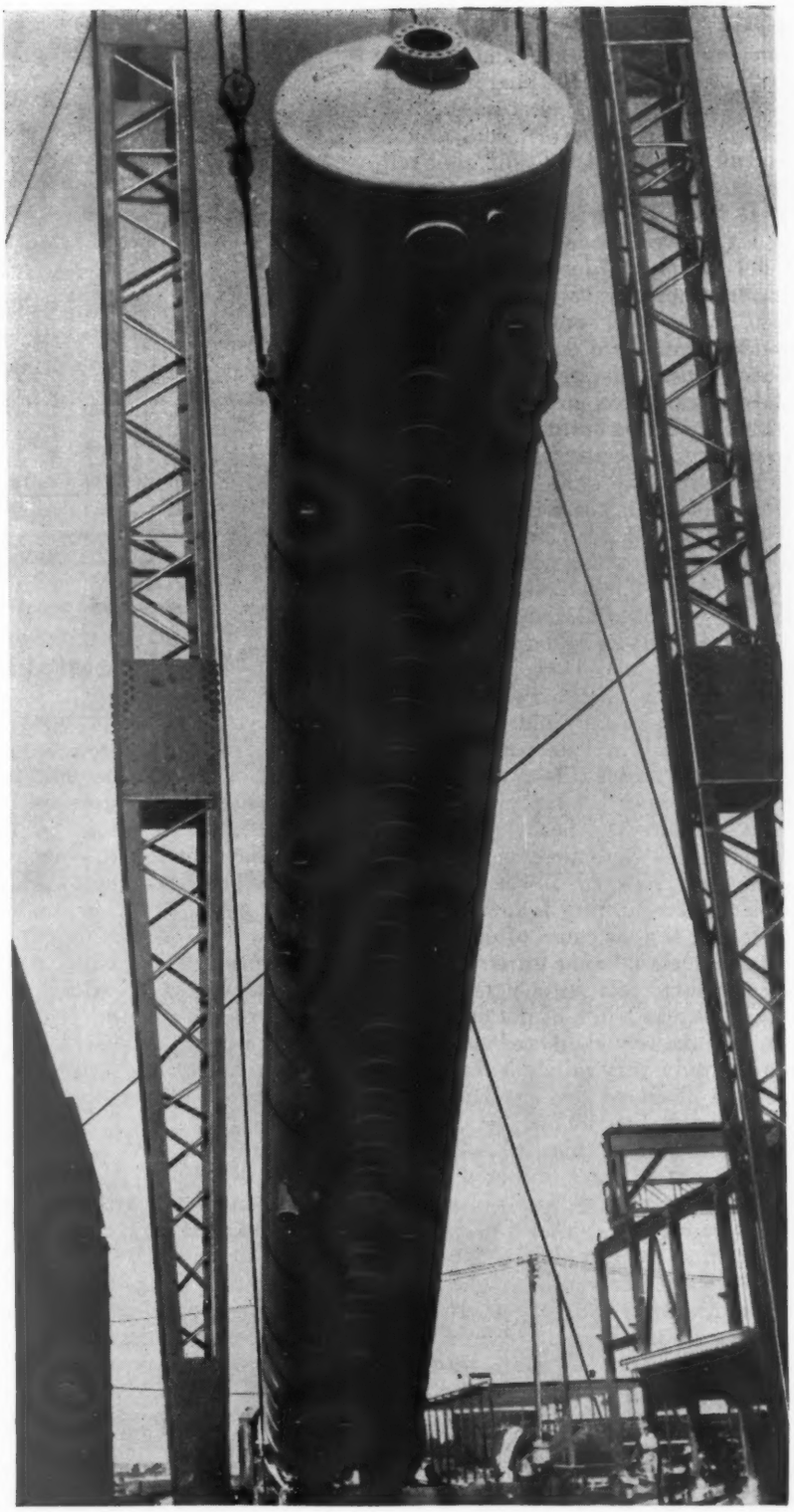

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sealed off by inserting a taper plug in one end, heating tube and plug to 600F, and welding the plug into place with 25-20 Cr-Ni electrodes. Inlet wearing ferrules were found eroded and all were "beaded down" after rolling to reduce this erosion. Carbon steel liners in the exchanger outlet cones showed eroded holes near the outer periphery, due to catalyst exiting from the tubes at high velocity. A 6-in. wide steel erosion band was welded over these outer areas of the liner. When this wearing band still showed excessive erosion, a Hexteel castable wearing surface was installed in each cooler. During another inspection more than 400 worn ferrules were replaced in three recycle catalyst coolers. Piping was changed on these units to reduce the pressure on the shell side of the coolers, thus reducing the differential between the gas oil cooling medium and the catalyst-air stream side to between 3 and 12 psig. When one of two waste gas coolers became seriously plugged during a run, the added load placed on the other cooler eroded its elements until it was necessary to replace 435 ferrules and plug 52 tubes. One hundred fifty ferrules were renewed and several tubes plugged in the stopped cooler. After-burning following shutdown is a serious cause of damage to metal materials. In one turnaround the third of three catalyst coolers showed severe leakage while of the other two one was entirely tight and the other showed only very minor leakage. Inspection disclosed that the inlet tube sheet had burned a hole some 2 ft diam, and several tubes were burned entirely out of their rolls, with two or three melted in two. Tubes and sheets were 4-6 Cr-½-Moly steel. Brinell hardness tests as high as 450 were shown by the burned sheet. The sheet was annealed by soaking at 1675 F for five hours, then it showed 185 Brinell. Tube holes were reconditioned by welding with 25-20 Cr-Ni electrodes, new tubes installed, rolled and seal-welded with 25-20, and new ferrules installed, rolled and beaded, to yield a tight exchanger.

Most other condensers and exchanger-coolers, handling vapors or hydrocarbon liquids, are washed with water, inspected and leaks welded tightly. Removable bundles are sandblasted to permit inspection and repair or replacement.

Slide Valves

Feed valves show erosion frequently on slide and seat opposite the point of attachment of the valve stem, necessitating welding repair or replacement. All parts are repaired or replaced normally, and the stem repacked, whenever the unit is down. The spent catalyst valves are in a condition similar to those on the feed line. The smaller (8½-in.) control valve, with a square port opening, was eroded most, the 12-in. main valves requiring only small repairs. These valves have "home base" type openings. Clearances of 0.012-in. to 0.016-in. between slide and seat is maintained on these valves. In general the wear on these slide valves is not too severe under proper operating conditions.

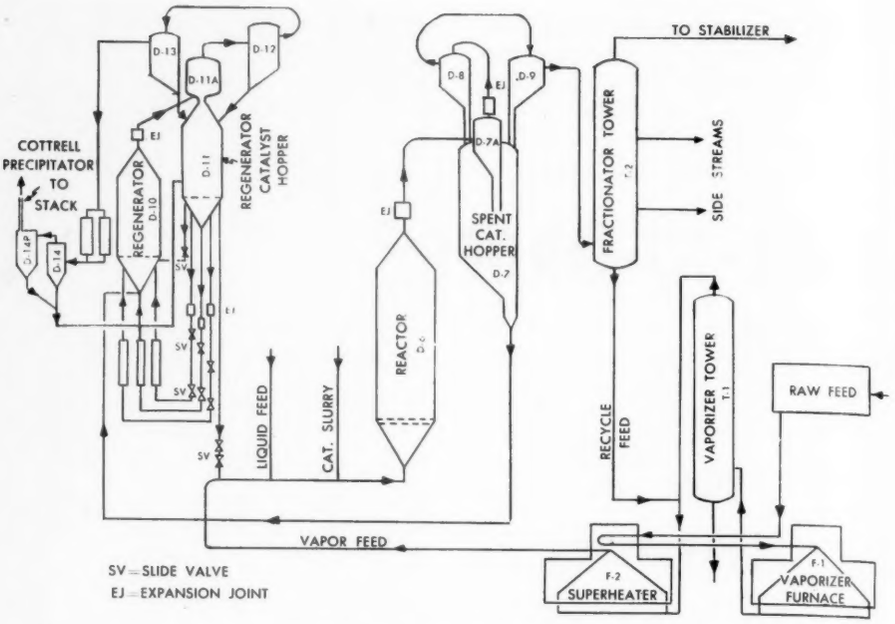

FIG. 14. Simplified flow chart of fluid catalytic cracking unit.

Expansion Joints

Erosion is the greatest danger to the large diameter expansion joints used in the fluid units, with corrosion occurring in some locations. Rectangular type expansion joints in the precipitator outlet lines have shown corrosion, which is repaired by welding on plates, and an effort has been made to reduce corrosion by externally insulating them heavily.

No. 14 gage bands, often of 347 type steel alloy, are welded frequently over breaks and holes, which occur in the different bellows sections of the expansion joints. Whole elements, generally of 347 type alloy, are installed when required. Because of the severe service that these joints are called on to give, it is probable that they will require a considerable amount of repair, normally of relatively simple breaks and holes, and requiring no highly specialized methods or technique to accomplish properly.

Inspection, repair, and replacement of most other items in the catalytic cracking unit are little if any different to the same operations in any refining unit and will not be discussed in detail here because, ordinarily, good refinery practice that has been developed over the years is quite satisfactory. The details given here regarding the special units of the cracker are, admittedly, small in number but serve to indicate the methods, means, and materials employed in maintaining these units, the experiences that have come to the operators, and the ways that they have learned to meet the problems.

Nor is it to be supposed that the problems mentioned here are out of the ordinary or that they indicate any but the most careful methods of operation. Catalytic cracking is new, the great majority of the problems of operation are completely new, revolutionary, and never have been faced before by refining operating engineers. It was necessary that they be tackled, lived with, solved. In the solving of them, some materials and practices were proved unavoidably to be unsatisfactory; new methods and materials were found, and worked out, to handle the difficulties. A rapidly moving solid catalyst is highly erosive, no matter how finely divided it may be. Changes in direction of flow causes accelerated erosion, and wear plates must be employed to save the main elements of the unit. The best materials for this job have to be developed, and so goes the story of the evolution of the technique of operating a "cat cracker." These brief notes are given here in the hope that they will help all operators solve some of their individual problems. ***

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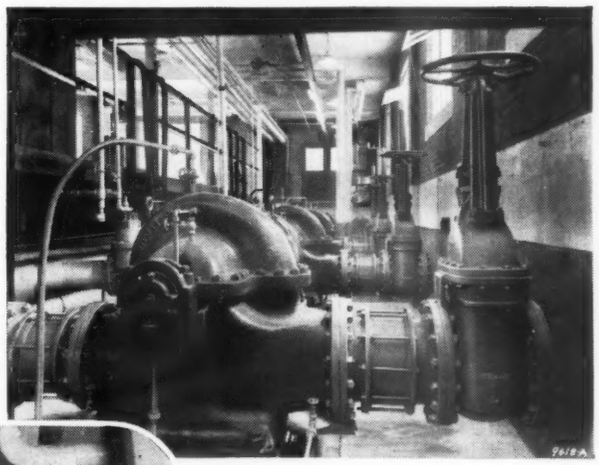
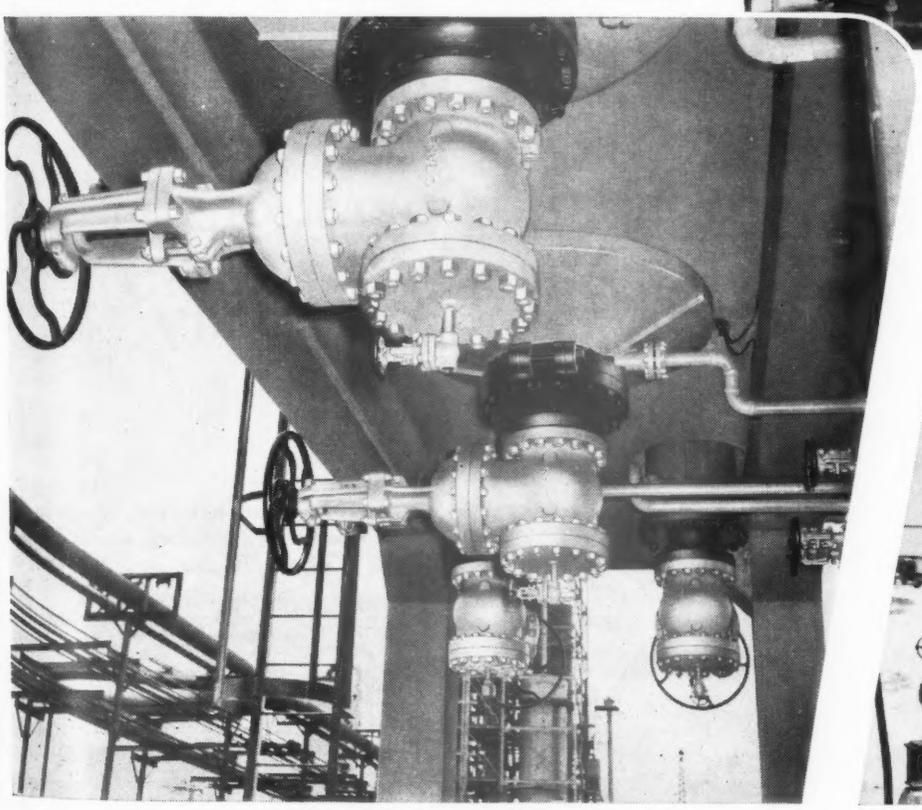
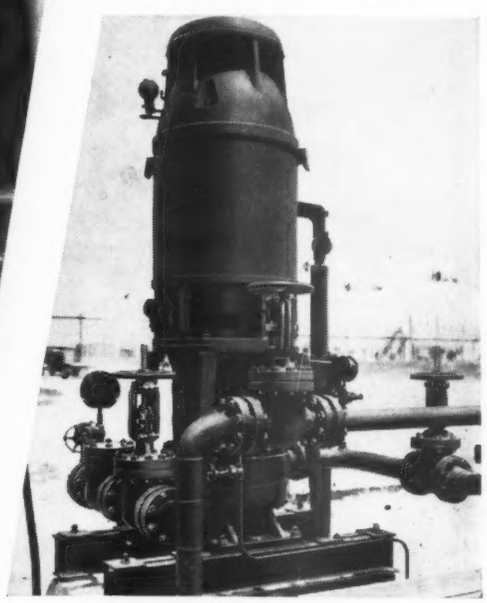


BAUXITE FILTERS *in HF alkylation unit featuring Crane 300-pound steel gate valves. Crane supplies everything for installations of this type.*



PIPE LINE PUMPS *at butane pump station—large and small 600-pound steel gate valves are from the complete Crane line.*



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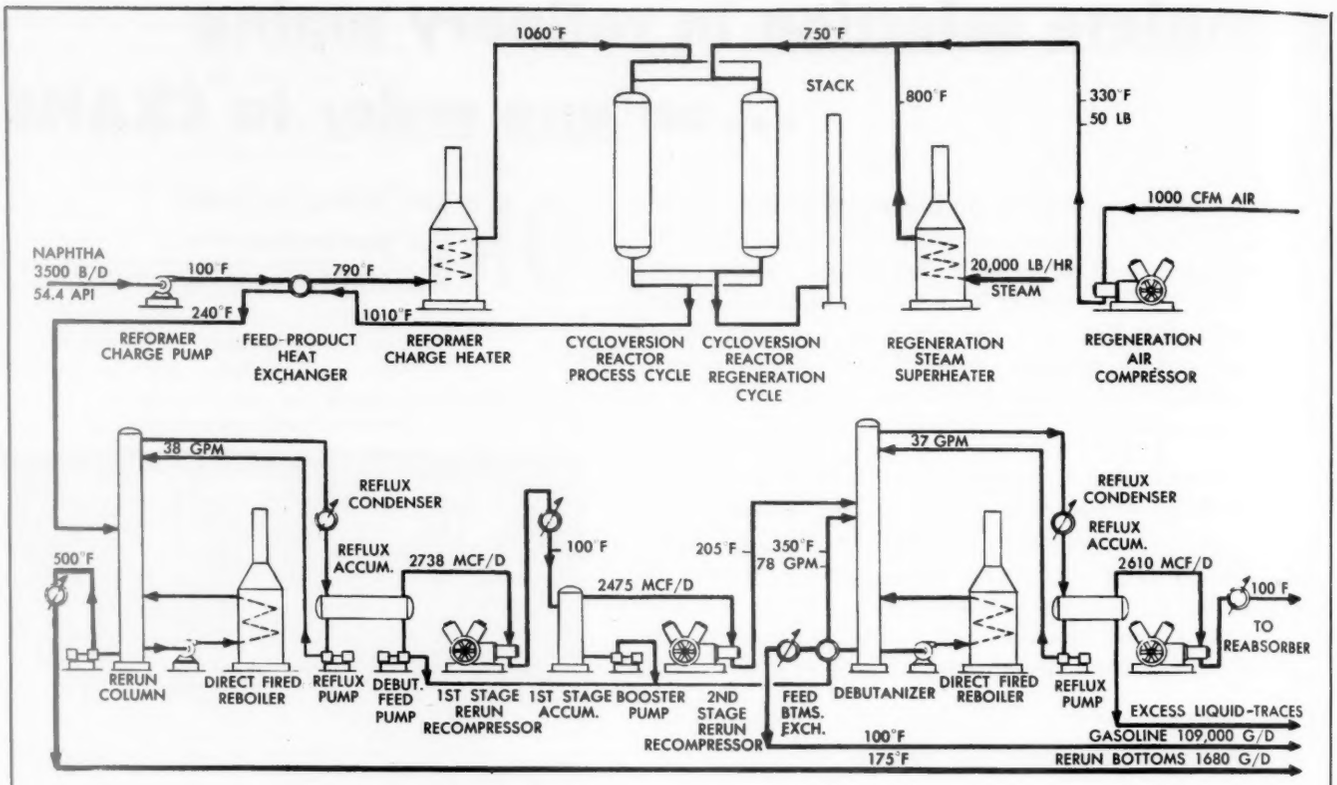

FIG. 1. Cycloversion process flow diagram.

Catalytic Reforming Operations at McCarthy Chemical Company

HUGH A. NEAL* and C. B. AMES†

DURING recent years, the shortage of motor fuel in the country has made the problem of selling these products very simple. Now, with relatively large stocks of gasoline existing throughout the country, the refiner is faced with a declining market for low octane quality motor fuel. The immediate problem of upgrading low octane motor fuel and increasing the spread between ASTM and research octane ratings to obtain premium prices is of great importance, especially to the natural gasoline industry and the small refineries. This article concerns a combination catalytic reforming and cracking plant of the Cycloversion type, and should be of interest to the industry, assuming the present marketing trends continue.

The McCarthy Chemical Company placed their Cycloversion catalytic process plant in operation during June of 1948. This plant is located in Winnie, Texas, approximately 20 miles southwest of Beaumont, Texas, and is operated in connection with a natural gasoline absorption plant. The design capacity of the reforming unit is based on the total products from their existing gasoline plant and the addition of one similar unit now being placed in operation. During the initial test period, the plant was operated at capacity. The result of these operations will be presented later. During the construction of the additional absorption plant, however, when insufficient design feed stock was available, the Cycloversion unit demonstrated its feasibility by charging the total full range gasoline production, together with sufficient raw field condensate to load the unit.

The unit was designed primarily to handle 3500 bbl per day of naphtha charge stock with an initial boiling point of about 200 F and an end point of about 430 F. The percentage recovery of the reformed product will be proportionate with the spread desired between ASTM and research octane ratings. This can be explained better by saying the quantity of reformed motor fuel increases with relation to charge rate where a lower spread in octane rating is acceptable. Table 1 shows pilot plant data for one

*Plant Manager, McCarthy Chemical Company.
†Vice President, Fish Engineering Corp.

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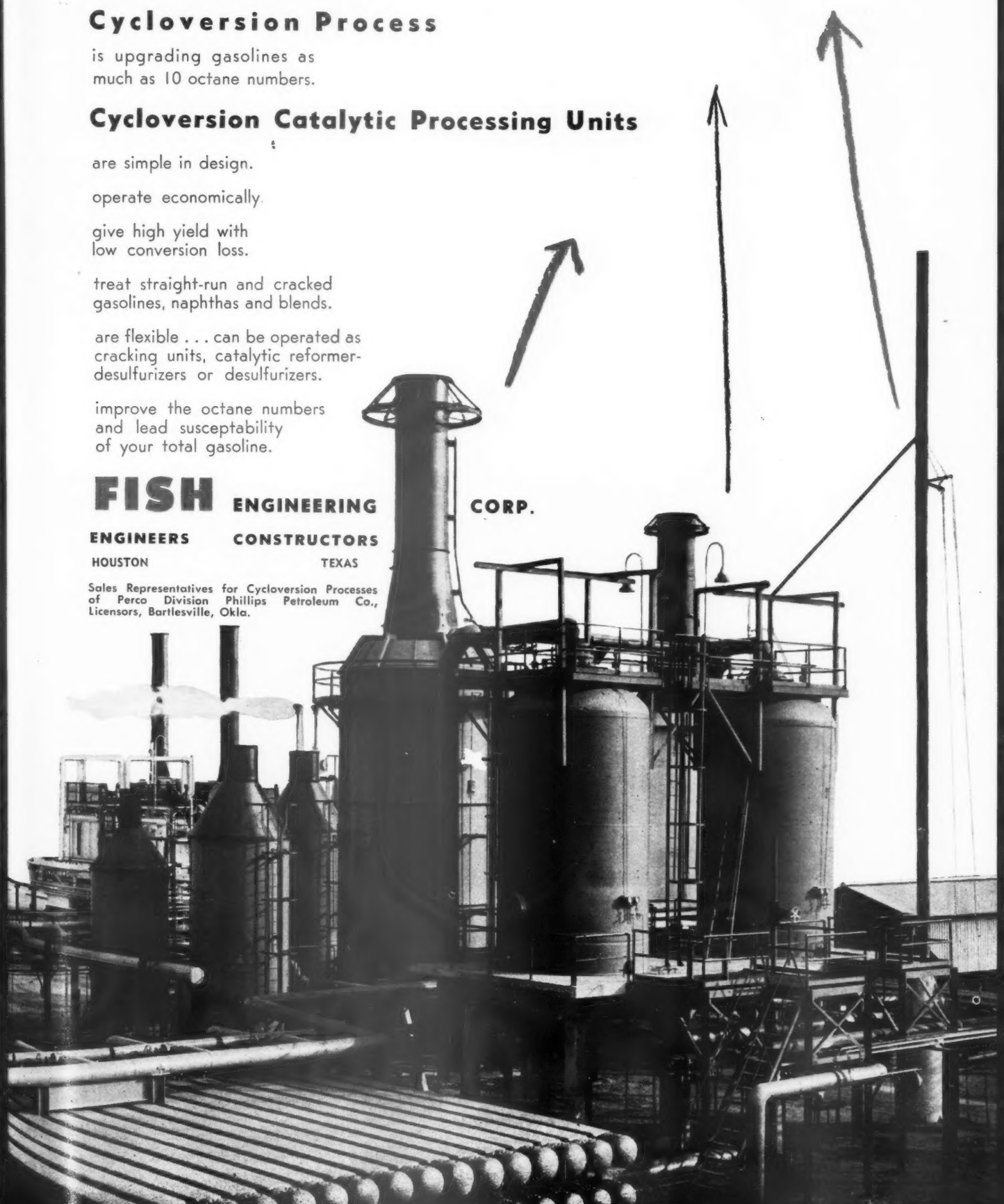
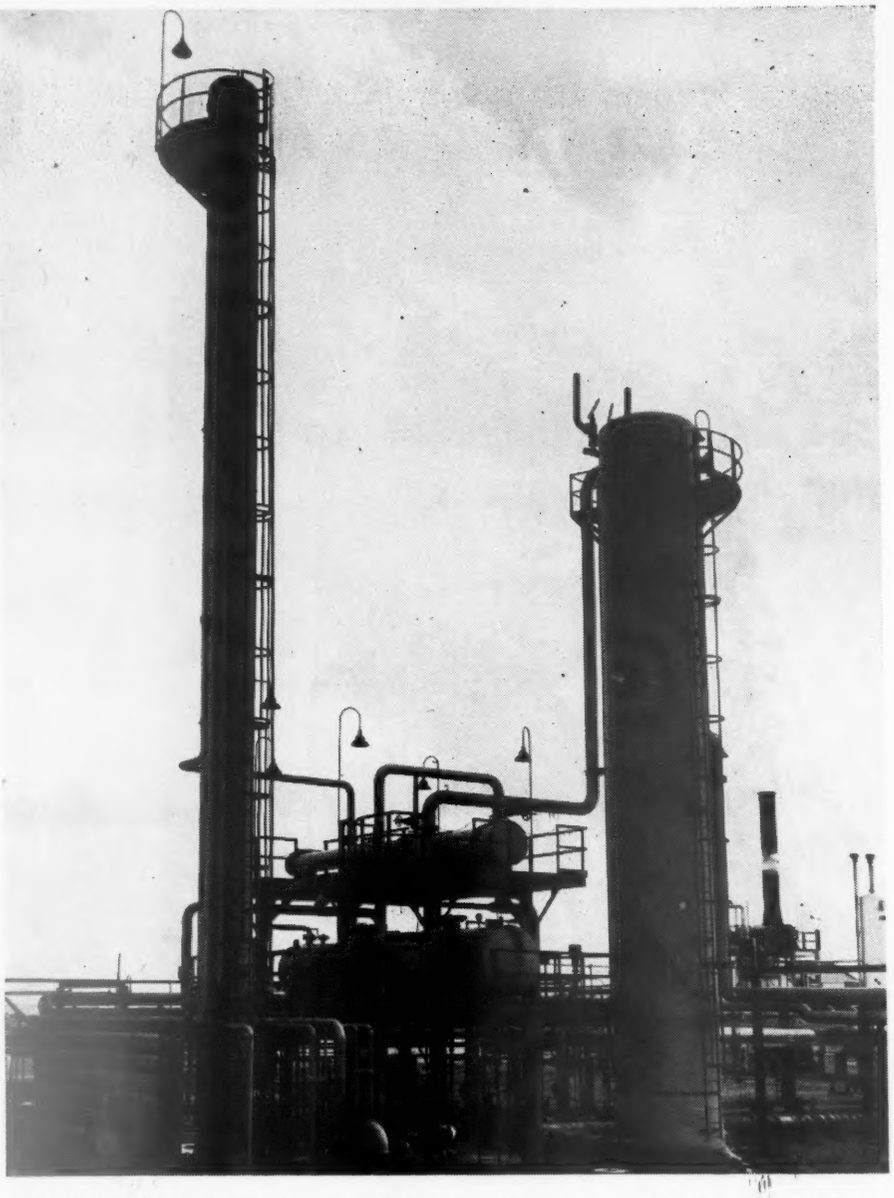




Debutanizer and rerun columns with feed exchangers, condenser, accumulators.

comparison of octane ratings between the charge stock and the final product.

The above operation, with a naphtha charge stock of 3500 bbl per day would result in a recovery of 2600 bbl per day of 6½ RVP reformed motor fuel.

Pilot plant operations indicate that in this case it was more desirable to size the plant to charge the naphtha strength rather than the full range motor fuel, which is equivalent to upgrading a total of 5000 bbl per day of full range motor fuel. This Cycloversion process unit has a wide range of flexibility, besides reforming the naphtha or the full range motor fuel; it is capable of cracking catalytically approximately 2000 bbl per day of kerosine or gas-oil charge stock.

Fig. 1, Process Flow Diagram, shows the design rates and the general flow through the Cycloversion process unit on the basis of the naphtha charge stock. The naphtha charge is pumped through the feed-product exchangers where the feed is completely vaporized and the temperature raised to 790 F. Feed vapors from the outlet of this exchanger enter the main charge heater where it is superheated to a design maximum temperature of 1060 F. The superheated vapors enter the catalyst chamber at the top, flowing downward through the bed where catalytic reforming takes place.

The product vapors leaving the bottom of the catalyst chambers pass directly through the feed exchanger and into the rerun fractionating column. This column separates the reformed motor fuel and lighter products overhead and removes a 400 IBP fuel oil as the bottom product. The rerun column overhead, consisting of liquid and non-condensable vapors, is charged into the debutanizer column by pumping the liquid through a feed exchanger and compressing the vapors through two stages. This column acts as a stabilizer separating the specification motor fuel as a bottom product and passing overhead the remaining butanes and lighter components which are partially condensed, furnishing the reflux for this column. The uncondensed vapors from the reflux accumulator are then recompressed through a single stage and passed back to the gasoline plant.

TABLE 1. Pilot plant operation.

	Original plant — octane ratings —		Reformed gasoline — octane ratings —	
	ASTM	Research	ASTM	Research
Clear	58.7	60.7	73.4	79.4
1cc	71.8	71.4	81.3	87.1
3cc	80.0	81.7	85.2	91.4

During the process operation a carbon lay-down occurs in the catalyst bed which requires periodic regeneration. In order to provide for continuous operation of the unit, two catalyst chambers are used operating on an alternating basis; one reforming and the other regenerating over a 12-72 hour cycle as required. The regeneration of the catalyst bed is accomplished by introducing a mixture of superheated steam and air into the chamber. The usual procedure in regenerating one of the chambers consists of sweeping out all remaining hydrocarbon vapors by use of superheated steam. This operation usually requires about 20 min and then air is gradually introduced into the superheated steam until the desired ratio is obtained.

A close check is kept on the flame front as it progresses through the catalyst bed, by means of thermocouples placed at close intervals. These temperature points are connected to a recording type potentiometer. It has been found that a consistent pattern is recorded by the potentiometer during the regeneration cycle with each point in progressive order, ranging upward from the temperature of the superheated steam, 800 F, to the flame front temperature of 1400 F, thus serving as a guide during regeneration periods. The hot vapors leaving the bottom of the catalyst chamber during the regeneration period, are quenched by injecting water condensate or low pressure exhaust steam into the vapor line cooling it to a temperature of approximately 800 F before discharging through a stack to atmosphere.

Tables No. 2, 3, and 4 are based on the test operation of the unit. Since the existing gasoline plant production was limited and the test operation of

C. B. Ames, co-author, is vice president of The Fish Engineering Corporation. He was a member of the engineering staff of Stearns-Roger Manufacturing Company for 12 years before joining the Fish Engineering when it organized in 1946. Ames has taken part in the design and engineering of various types plants connected with the oil and gas industry during the past 15 years.

the unit depended largely on the combined plant production and storage capacity, a full range motor fuel was used as charging stock. When the enlargement of the gasoline plant is complete and in operation, sufficient charge stocks of various grades will be available for continuous operation of the unit at its full design capacity. Table 2 shows the detailed breakdown of the plant volume and weight balances for one 48-hr test period and one 72-hr test period at design capacity when charging full range motor fuel.

Table 3 shows the detailed breakdown of the charge and product analysis for the test periods covered in Table 2. The charged product to the Cycloversion unit during the period of these tests as analyzed showed ASTM and research octane numbers of 79-81 with 3 cc TEL per gallon.

Table 4 is a typical Podbielniak fractional analysis of the discard vapor leaving the debutanizer reflux accumulator for the test periods covered in Table 2. Table 5 is a summary of the utility requirements when operating at design capacity.

The mechanical features of the unit follow conventional practices, with the exception of the catalytic processing unit, its auxiliary equipment and piping. Since the operating temperature of the catalyst chambers falls in the 1000-1050 F range, it was necessary to use 4-6 chrome 0.5 per cent Molybdenum pipe and valves. At this elevated temperature, the alloy pipe had an expansion rate of approximately 3/4 in. for each 10 ft of length.

Values of Young's Modulus developed by sonic methods were used in

TABLE 2. Plant balances.

	48-hour test period			72-hour test period		
	Gallons	Volume % of charge	Pounds	Gallons	Volume % of charge	Pounds
Charge	293,504	100.00	1,719,933	453,591	100.00	2,655,322
Gasoline	270,548	92.18	1,585,411	413,256	91.11	2,429,945
Fuel oil	1,080	.37	9,059	2,320	.51	19,432
Gas and loss (by diff.)	21,876	7.45	125,463	38,015	8.38	205,945
Gas by measurement	.....	.....	162,157	.....	.....	248,056
Gain	.....	.....	36,694	.....	.....	42,111

TABLE 3. Analysis of charge and products.

	48-hour test period			72-hour test period		
	Charge	Gasoline	Fuel oil	Charge	Gasoline	Fuel oil
Gv. °API	68.9	68.4	8.9	70.2	67.5	9.8
RVP	9.7	8.8	....	11.0	8.5	....
ASTM distillation						
IBP	90	96	453	84	98	464
10%	118	122	482	112	128	481
30%	149	149	496	142	152	496
50%	192	187	517	185	190	520
70%	244	238	562	241	239	565
90%	334	324	682	330	324	684
E.P.	412	408	690	410	406	684
Octane numbers						
ASTM						
Clear	....	66.3	....	....	66.3	....
3cc	....	84.0	....	....	83.9	....
Research						
Clear	....	71.3	....	....	71.3	....
3cc	....	89.0	....	....	87.1	....

Catalytic processing unit including catalyst chambers, product exchangers, and heaters.

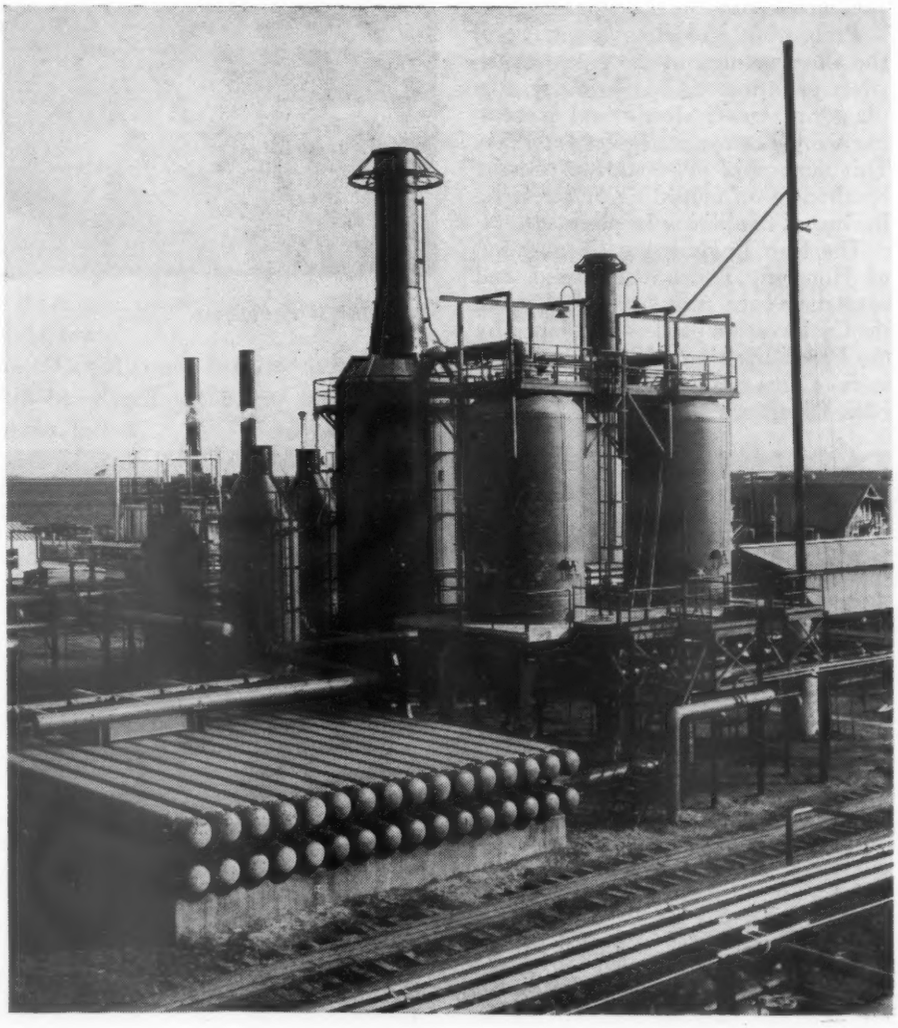


TABLE 4. Analysis debutanizer net overhead vapor.

Component	Mol. %
Hydrogen	61.28
Methane	12.35
Ethylene	3.88
Ethane	6.57
Propylene	5.94
Propane	.99
Iso Butane and Iso Butylenes	1.74
N-Butanes and N-Butylenes	6.14
Isopentenes and heavier	1.11

TABLE 5. Utility requirements.

Plant design load.

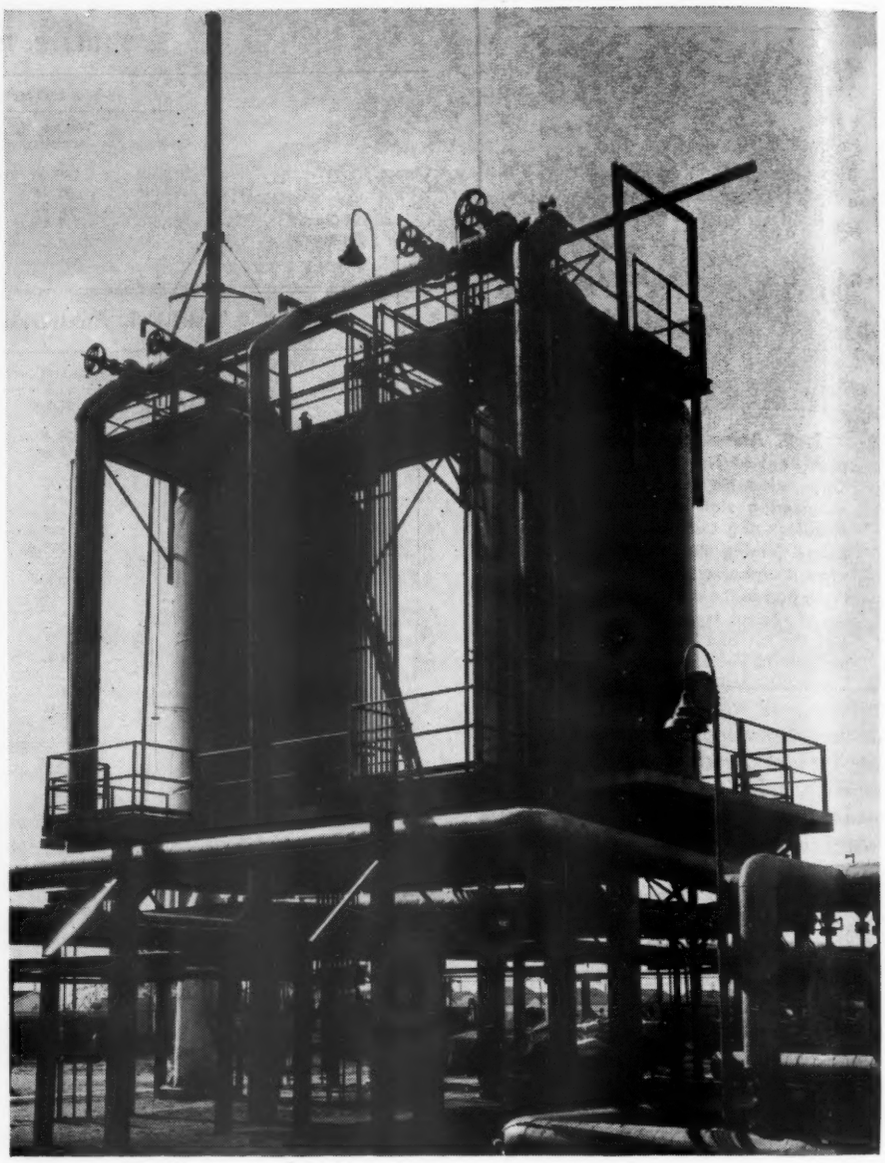
Pumping steam	4,350 lb per hr.
Electrical power	40 KW
Fuel gas	1,210 MCF/D
Cooling water	1,620 GPM
Regeneration steam	20,000 lb per hr.
Regeneration air	1,000 CFM

pipe expansion corrections. Transverse stresses on flanges were arbitrarily limited to 500 lb per in. of pipe diameter. Stresses in pipe due to pressure were set below the values for .01 per cent per 1000 hr, while combined stresses due to pressure and bending were set at values approximately equal to stress rupture per 100,000 hr. This procedure was considered proper, since bending stresses at this temperature rapidly dissipate leaving only pressure stresses in the pipe.

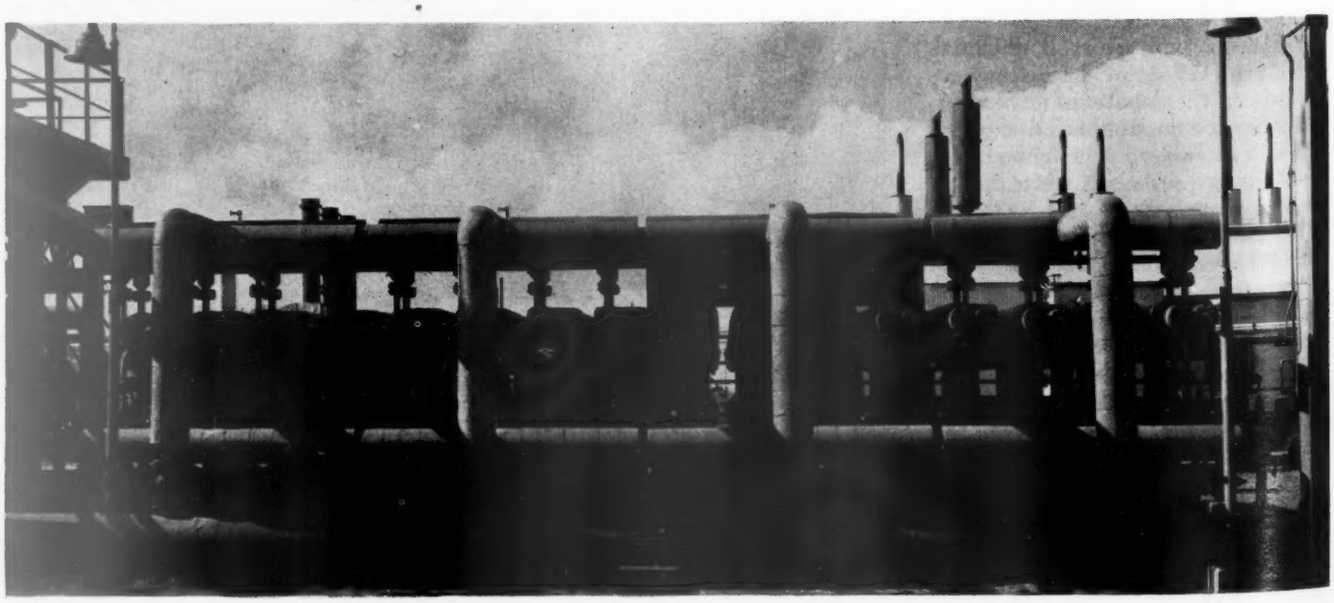
Preheating and stress relieving of the alloy welding of the pipe was entirely eliminated by bringing the plant on stream slowly and increasing temperatures at regular intervals. This method of plant startup actually resulted in an annealing or stress relieving of the piping in place.

The Fish Engineering Corporation of Houston, Texas, engineered and constructed the complete plant, using the Cycloversion process developed by the Perco Division of Phillips Petroleum Company, Licensors, Bartlesville, Oklahoma.

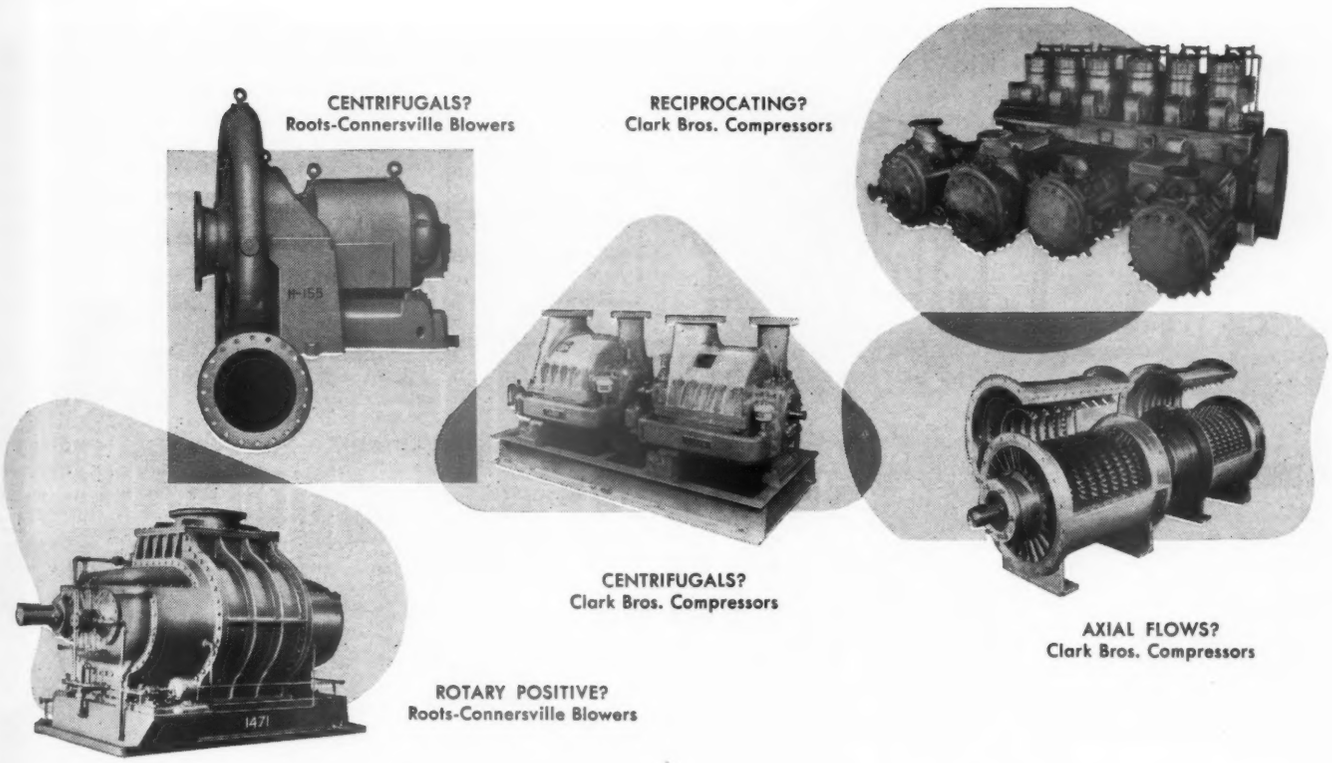
* * *



Catalyst chambers.



Feed-product exchangers.



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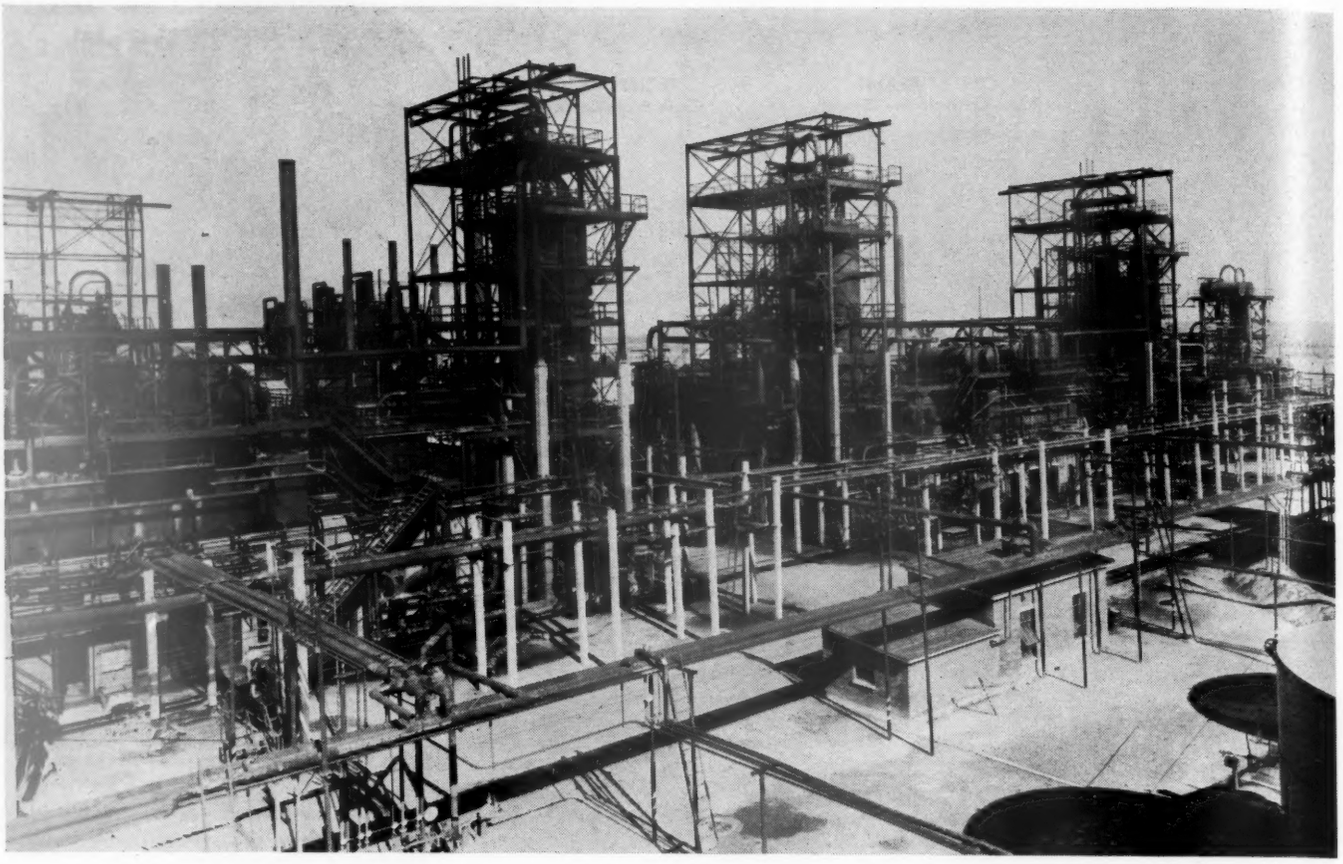


These three units have employed the suspensoid principle.

Catalytic Effects in Suspensoid Cracking

C. H. CAESAR*

Suspensoid Catalytic Cracking has been under intensive research by refining technologists of Imperial Oil Ltd., under the direction of veteran Dr. R. K. Stratford, for nearly two decades. In this issue appears an article discussing the most recent findings in the study of this unique method of rearranging hydrocarbon molecules. These researchers find that this process has features in common with both pyrolytic and catalytic cracking. Use of the suspended catalyst eliminates or minimizes deposition of carbon in the heater coil, a very important reaction, and the catalyst improves octane ratings, increases yields of C_4 hydrocarbons. Isomerization, polymerization, alkylation reactions as well as pyrolytic and catalytic cracking, appear to occur in varying degrees in the process.

*Imperial Oil Ltd., Ontario, Canada.

Introduction

RESEARCH which has been conducted in the Sarnia laboratories of the Imperial Oil Ltd., on the subject of suspensoid cracking, has been essentially of the applied type in that it has been directed toward the development of a practical process with immediate applications in mind. Descriptions of pilot plant and refinery units, and of the general results of suspensoid cracking have appeared in previous publications (1-5). It is the purpose of this paper to discuss the fundamental nature of the process, especially with regard to its catalytic aspects. Since the experiments were concerned with feed stocks and operating conditions typical of refinery practice, the reactions involved were extremely complex and the methods of testing were largely of the empirical type which have been developed in the industry. As a consequence, the study is essentially of a qualitative rather than a quantitative nature.

Definition

Suspensoid cracking is a process for the conversion of petroleum hydrocarbons in which the feed stock, together with a small amount of catalyst or contact agent, is charged to a reaction coil of a type familiar to the industry for pyrolytic cracking. Feed stocks may range from naphthas to high-boiling gas oils or any mixtures of such components, while typical operating conditions are: coil outlet temperatures 1030-1130 F; coil outlet pressures 200-1000 psig; feed rates 6-14 V/V/hr. (volume of cold feed per volume of reaction coil above 800 F per hour) and catalyst concentrations ranging from 2-30 lb per bbl of feed. Water may be injected with the heavier feed stocks to aid in vaporization, without which coking of the coil occurs.

The suspensoid process, therefore, differs from conventional pyrolytic cracking in that a catalyst is employed and temperatures appreciably higher than those attainable in purely thermal operations are possible, thus permitting gasolines of higher antiknock rating to be produced. It differs from conventional catalytic cracking processes in that the concentration of catalyst is very much smaller (in the order of 0.1 per cent of that used in "fluid" catalytic cracking) and that operating pressures are much higher.

THE EFFECT OF OPERATING VARIABLES

Catalyst

In addition to the primary reaction of carbon bond scission, secondary reactions such as isomerization, polymerization and condensation are extremely important in catalytic cracking processes. Studies by Thomas, Greensfelder and others who have investigated the reactions of pure compounds in fixed bed catalytic cracking experiments, have demonstrated that typical cracking catalysts have distinctive effects, some of which are as follows:

1. The catalyst exerts a differential effect on the rate of carbon bond scission. Large molecules are cracked much more rapidly than small ones of the same molecular type.[6] As a consequence, light naphthas charged to Fluid, Thermofor, or Houdry cracking units are recovered in the products virtually unchanged unless unusually severe conditions are employed.

2. In contrast to thermal cracking where the rupture of the molecule takes place at almost any carbon bond, according to the laws of chance and ferquently near the end of the carbon chain, cracking catalysts favor the splitting off of groups of three or more carbon atoms.[6] As a consequence there is relatively little dry gas, (particularly materials lighter than propane) and a very high percentage of butanes in the cracked products.

3. Naphthenic compounds are cracked more readily than paraffinic compounds,[7] which is the reverse of thermal cracking experience and explains the relatively high pour points of the cycle stock from the above processes.

4. A high percentage of isoparaffins are found in the catalytically cracked gasoline.

5. It has been found that cracking catalysts are active polymerization agents.[8] Condensation reactions between olefins and aromatics have also been demonstrated.[9] Such reactions may result in the formation of cyclic compounds.

As has been explained, direct evidence of the above reactions is difficult to acquire from suspensoid cracking experiments on refinery type feed stocks. In view of the difficulties in obtaining "blank" runs at high conversions, the catalytic effects observed in suspensoid cracking may be evaluated by comparing the results secured when using good versus poor cracking catalysts. The data shown in Table 1 are typical of the results obtained when cracking mixed naphthas and gas oil feeds with catalysts of different activities in the suspensoid pilot plant. A study of these runs leads to the following observations:

1. The most important difference between two catalysts is the ability of the silica-alumina to impart higher octane numbers to the cracked gasoline.

2. Since the bromine numbers of the gasolines differed by only 10 cg. per g. and the aniline points were almost the same, the improvement in octane rating should not be attributed simply to the production of more olefins or aromatics in the gasoline. An increase in the percentage of isoparaffins may also be indicated.

3. The lower ratios of olefins to paraffins in the light hydrocarbon fractions obtained when using the silica-alumina catalyst suggest that this material has a higher activity for the conversion of the light olefins. The higher coke production also points to more extensive polymerization with this catalyst.

4. The ratio of gasoline to dry gas does not appear to be sensitive to the catalyst employed.

5. The higher yield of butanes produced when using the more active catalytic effects discussed above.

6. While there is some evidence that higher temperatures are required to produce a given conversion to dry gas when using less active catalyst, the data are not entirely consistent on this point.

In the case of naphtha feed stocks it is possible to observe the effects of the catalyst by direct comparison with conventional non-catalytic reforming runs. Typical results are shown in Table 2. As would be anticipated from the reduced effectiveness of catalysts on low molecular weight feed stocks referred to in the literature, the differences between thermal and suspensoid reforming results are not large, but they are quite distinct. The effect of the catalyst is to increase the octane number of the gasoline, reduce the percentages of olefins in the light hydrocarbon fractions and to increase the production of butanes. The increase in butane yield is largely at the expense of the heavier gasoline fractions, so that on the basis of gasoline yields of constant vapor pressure, there is no net gain for the catalytic operation in the yield of gasoline for a given octane number. On the basis of gasoline plus total butane yields, however, suspensoid reforming does show an advantage.

A demonstration experiment which clearly shows secondary reactions in-

TABLE 1. Comparison of Catalysts.

Suspensoid Cracking 40/60 Mid-Continent Naphtha and Gas Oil Feed.

Feed rate: 9 V/V/hr
Catalyst concentration: 10 lb/bbl
Temperature: Approximately 1065 F
Pressure: 600 psig

Catalyst		Bauxite	Silica-Alumina
Conversion to Dry Gas	wt per cent	18	18
Gasoline (400° FBP 10 lb RVP)	LV per cent	59	59
Heating oil (600° FBP)	LV per cent	12	11
Tar (-600° FBP)	LV per cent	9.0	9.0
Excess Butane (over 10lb RVP)	LV per cent	4.0	5.5
Coke (as carbon)	wt per cent	0.3	0.8
Ethane		8.9	9.3
Ethylene		3.9	3.4
Propane		7.4	8.2
Propylene		7.0	6.2
Butanes (total)		4.3	5.2
Butylenes (total)		5.6	5.7
Gasoline—			
Motor octane number clear		73.4	75.0
Research octane number clear		83.5	86.0
Aniline point, F		76	72
Bromine number, cg/g		70	80

TABLE 2. Effect of silica alumina catalyst in suspensoid reforming.

Feed: 53.5 deg API Mid-Continent Naphtha, 150-440F boiling range.

Feed rate: 9 V/V/hr
Catalyst concentration: 10 lb/bbl
Temperature: 1065F
Pressure: 800 psig

Catalyst		None	Silica-Alumina
Conversion to Dry Gas	wt per cent	20	20
Gasoline (400° FBP, 10lb RVP)	LV per cent	70.5	68.3
Excess Butane (over 10lb RVP)	LV per cent	4.1	6.5
Tar	LV per cent	5.9	5.2
Coke (as carbon)	wt per cent	none	0.7
Ethane	LV per cent	9.5	9.65
Ethylene	LV per cent	3.1	2.8
Propane	LV per cent	8.6	8.9
Propylene	LV per cent	6.6	5.9
Butanes (total)	LV per cent	5.0	7.3
Butylenes (total)	LV per cent	5.6	5.7
Gasoline—			
Motor octane number clear		73.9	74.7
Research octane number clear		84.6	85.4
Aniline point, F		79	82
Bromine number, cg/g		59	60

TABLE 3. Conversion of Butylenes.

Feed: Butanes wt per cent 18.3
Butylenes wt per cent 25.3
Naphtha wt per cent 56.4
Bath temperature: 900F
Coil pressure: 800 psig
Silica-Alumina catalyst: 10 lb per bbl

Products	Total	Estimated from naptha	Difference from butane-butylene charge
	(wt per cent on total feed)		
Dry gas	3.3— 3.7	2.3	1.0— 1.4
Butanes	22.8—26.9	0.7	22.1—26.2
Butylenes	6.8— 6.5	0.6	6.2— 5.9
Gasoline(C_5-430F)	62.0—59.0	52.0	10.0— 7.0
Heavy fuels (above 430F)	4.0— 2.9	0.3	3.7— 2.6
Coke	1.1— 1.0	0.5	0.6— 0.5

cluding hydrogen transfer reactions, illustrated in Table 3 in which butanes, butylenes and straight run naphtha were treated in the presence of silica-alumina catalyst under conditions too mild to result in any appreciable cracking. In this particular experiment the weight recovery was 93 per cent and the range of product yields shown represents the extreme limits obtained by assuming the loss to be in the feed or in the gaseous products. The results show that the total butane fraction which was recovered amounted to more than that charged, plus the small fraction which might have been cracked from the naphtha charge. The n-butane recovered was essentially the amount charged, while isobutane accounted for the whole of the net increase! The decrease in isobutylenes during the experiment was more than enough to account for the results by a hydrogen transfer mechanism. The gain in the quantity of pentanes and heavier hydrocarbons is clear evidence of the conversion of butylenes into heavier material which needs no further comment.

A similar experiment, performed under identical conditions to the above, but with benzene substituted in place of the naphtha in the feed, gave less isobutane in the product, suggesting that the naphtha had served as a hydrogen donor, but an interesting feature of the experiment with benzene was that appreciable quantities of toluene, xylenes and heavier aromatics and also some naphthenes were produced. Approximate conversions were calculated to be as follows:

	Wt, per cent
Butylenes converted to lighter products	4
Butylenes converted to isobutane	13
Butylenes converted to benzene alkylates	12
Butylenes converted to polymer	40
Butylenes unconverted	31
	100
Benzene converted to alkylate	15
Benzene converted to naphthenes	12
Benzene unconverted	73
	100

Although the primary reactions of carbon bond scission are determined largely by the thermal conditions in suspensoid cracking, it is evident that the catalyst plays an effective role in secondary reactions which are most important in determining product quality. This is especially remarkable in view of the small percentage of catalyst employed, and the relatively short contact times, in the order of 20 seconds, of residence in the reaction zone.

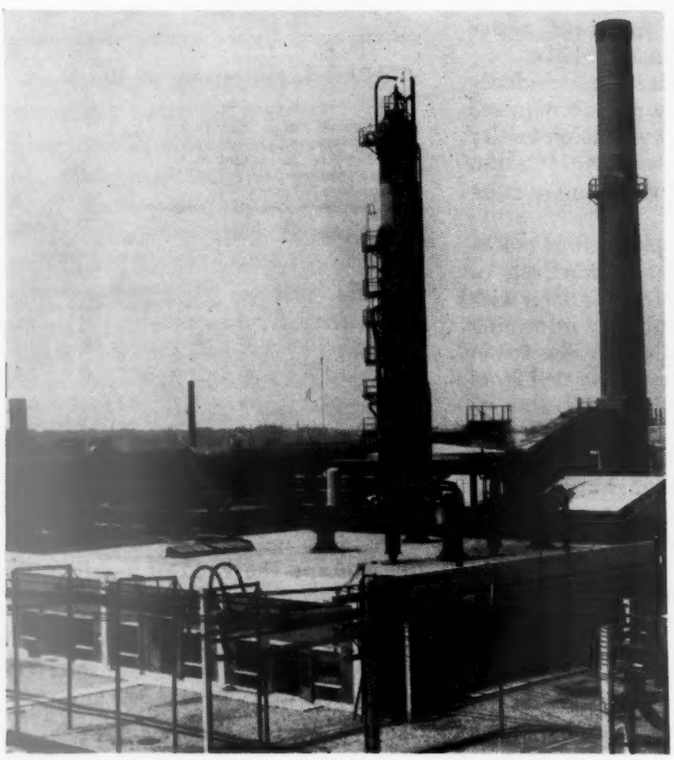
The catalyst also plays an important part in determining the operability of the process. While the point at which excessive coke deposits form on the walls of the cracking coil is governed by many variables, including conversion feed type, feed rate, the partial pressure of the hydrocarbons, the presence of water vapor, the linear velocity in the coil and the many aspects of furnace design, *it has been observed in refinery practice that a failure of the catalyst injection equipment results in a shutdown of the unit within a matter of minutes.* (Italics ours—Ed.).

It is generally considered that the production of coke in vapor-phase cracking operations is the result of complex reactions involving the separation of a small amount of a liquid-phase composed of high-boiling polymers. These liquid polymers coat the walls of the tubes and are subjected to high temperatures for prolonged periods as a result of which further decomposition and polymerization reactions take place with the ultimate production of coke.

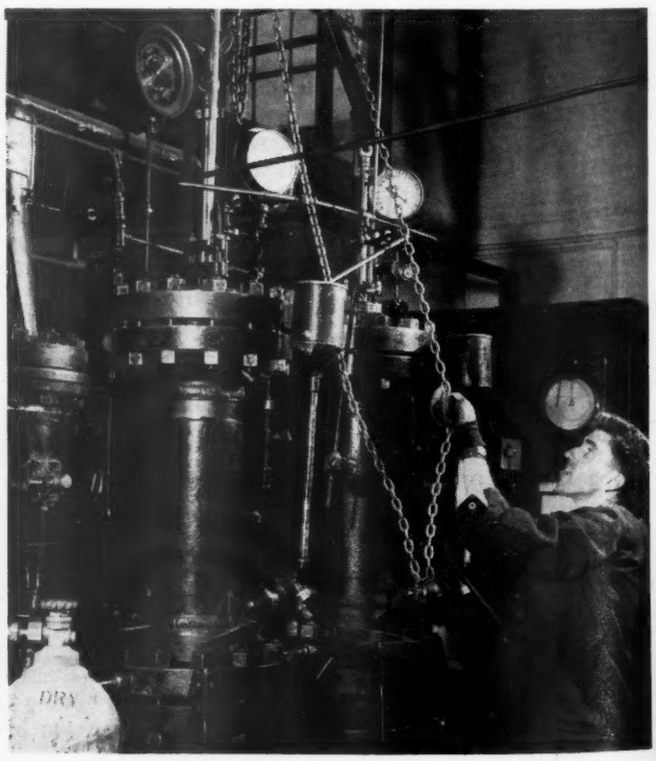
It is therefore apparent that in the suspensoid process the catalyst could be effective in improving operability by (a) scouring the surface of the coil in such a manner as to remove carbonaceous deposits and (b) adsorption of high-boiling polymers on the surface of the catalyst before a separate liquid phase appears. It is probable that both mechanisms take place since it has been shown that an inert material such as silica flour does contribute, to some extent, in improving operability.

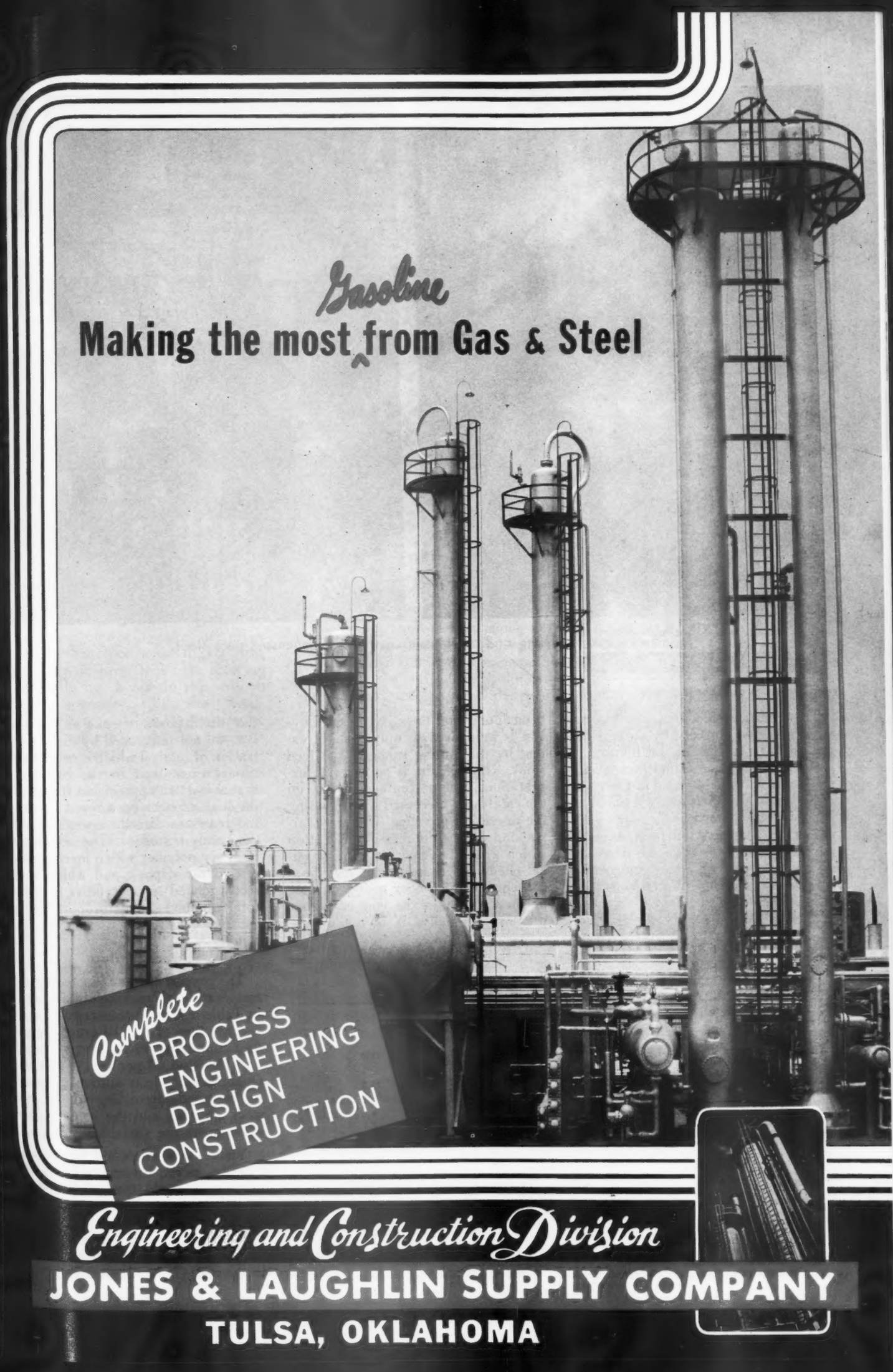
This rudimentary theory accounts

Part of the Sarnia layout.



Suspensoid cracking reactors.

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Two views of towers, and other equipment in the suspensoid pilot plant.

for the improvement in operability which may be obtained by decreasing the partial pressure of the hydrocarbon feed or by increasing the concentration of catalyst charged to the coil. However, it does not account entirely for the coke deposits which are produced on a catalyst surface. As was pointed out above, the coke deposits on the catalysts are almost independent of the severity of cracking, although the coking tendency is known to increase with severity. It has also been found that the coke on the catalyst is influenced to only a slight extent by the boiling range of the feed stock, which again, is contrary to expectations. The percentage of coke on the catalyst is increased by increasing the operating pressure. This may correspond to the increased adsorption which would be expected upon physical chemical grounds or it may be a consequence of longer residence time of the catalyst in the coil at higher pressures. Finally, it is noteworthy that the deposits of coke on the catalyst are not influenced by the concentration of catalyst which is used. These observations lead to the conclusion that at least an appreciable fraction of the coke deposits are a result of cracking reactions directly associated with the catalyst surface. The adsorption of heavy polymer which makes up the rest of the deposit and which is directly related to operability is, therefore, not necessarily proportional to the total coke production on the catalyst.

TABLE 4. Effect of temperature.

Feed: 40 per cent naphtha, 60 per cent gas oil (Mid-Continent).
Feed rate: 9 V/V/hr
Catalyst: Silica-Alumina, 10 lb per bbl
Coil pressure: 600 psig

Coil outlet temperature, F		1040	1100
Product distribution:			
Dry gas (propane and lighter)	wt per cent	14.8	22.5
Gasoline (400° FBP 10lb RVP)	LV per cent	62.0	54.0
Heating oil (600° FBP)	LV per cent	12.8 (24.5° API)	9.3 (20.7° API)
Tar (600° F)	LV per cent	[9.1 (4.4° API)	8.9 (0.7° API)
Excess butane (over 10lb RVP)	LV per cent	4.3	7.1
Coke (as carbon)	wt per cent	0.8	0.8
Hydrogen and methane	wt per cent	2.1	4.7
Ethane	LV per cent	6.8	13.0
Ethylene	LV per cent	3.0	4.0
Propane	LV per cent	7.2	9.6
Propylene	LV per cent	5.7	6.8
Butanes (total)	LV per cent	5.4	5.6
Butylenes (total)	LV per cent	4.8	6.6
Gasoline—Motor octane number clear		74.0	76.6
Research octane number clear		84.4	88.5
Aniline point, F		84	63
Bromine number, cg/g		73	87

Temperature

The general effects of increasing the temperature of cracking are illustrated in Table 4 which presents data for an average type of 41 API gravity mixed feed containing 40 per cent of natural naphthas and 60 per cent of gas oils. Quantitative effects differ, as would be expected, according to the feed stock charged and the values of the other operating variables.

Yields of the lighter hydrocarbons increase, as the temperature is raised, at approximately the rate to be expected from pyrolytic cracking correlations. The dry gas (propane and lighter) production increases about 1.3 per cent for each 10 F temperature increment. (It has been found in the

pilot coil that dry gas production is a more reliable measurement of the severity of cracking than the coil outlet temperature, and forms the most convenient basis for estimating conversions of feed to the various products.)

The decrease in gasoline yield with increasing temperature is a normal consequence of reforming the naphtha portion of the feed stock. Likewise, the decrease in gas oil yield parallels pyrolytic cracking experience. Yields of normally liquid products are very dependent upon the composition of the feed stock, as discussed below. In the example given, the yield of tar appears to be independent of temperature but the change in gravity shows this to be a result of compensating reaction—cracking versus polymerization and condensation.

It is evident from the decrease in aniline point and relatively smaller increase in bromine number that the improvement in gasoline octane number with temperature is a consequence of a relative increase in the percentages of both aromatics and olefins in the gasoline at the expense of paraffinic constituents.

The effect of temperature in increasing the percentage of olefins in a given fraction decreases in the lighter cuts, the propane-propylene cut showing essentially no change in composition with temperature, while the ethane-ethylene fraction shows a decrease in the per cent ethylene as the temperature is increased.

It is of interest that the carbonaceous deposits (coke) which form on the catalyst are not affected by increases in conversion due to increased temperatures, a point which was discussed above.

Pressure

Operating pressures appreciably below 200 psig are avoided in the present commercial suspensoid cracking coils because of the tendency of the catalyst to erode return bend headers. Higher pressures lower the linear velocity of the charge through the tubes and thereby decrease erosion. They also offer an advantage in furnace capacity when heat input is limiting since the increased residence time in the coil compensates for lower coil temperatures to effect a given conversion. Furthermore, high pressures favor the production of more stable gasolines. However, an upper limit to the operating pressure, which varies with the feed type and other operating conditions, is imposed by the tendency to deposit coke on the tube walls and headers. In the latter, the coke deposits frequently result in impingement of the catalyst on the metal walls with localized erosion as a consequence.

As in conventional pyrolytic cracking, the use of high pressures tends to suppress the yields of light olefins. At a given conversion to dry gas, yields of gasoline from the 40/60 mixed feed discussed above are approximately one per cent higher when operating at 600 psig than at 400 psig. Evidence of an octane advantage for operations at high pressures is, however, inconclusive.

Feed Stock Type and Feed Rate

Gasoline, heating oil, and tar yields are particularly affected by the feed stock composition. As would be expected, the higher the percentage of the feed which boils within a given range of temperatures, the greater is the yield of product boiling in the same range. Product distribution does not appear to be affected by the type of crude from which the feed stock was derived, but the less paraffinic feeds produce gasolines of higher octane numbers than the other types, presumably due to a correspondingly low percentage of normal paraffins in the cracked gasoline. This effect was illustrated in a previous publication.[4]

The octane number requirements of the newer high compression engines are such that it is becoming imperative to decrease the percentage of the natural naphtha in the gasolines produced in most refineries. In cases where suspensoid cracking units are available, it is advantageous to accomplish this by charging the natural naphtha along with the gas oil cracking coil feed, rather than by reforming the naphtha separately. An appreciably higher gasoline yield is obtained from the mixed feeds, when cracking to a given pool octane number, due to the fact that the gas oil may be cracked more severely and the naphtha correspondingly less severely in the mix than is feasible when processing these stocks separately in a suspensoid unit. There is also some evidence of chemical interaction of the components in the coil which contributes to the advantage for this procedure.

References

1. Arch L. Foster, Oil and Gas Journal, May 4, 1944.
2. Arch L. Foster, Oil and Gas Journal, March 30, 1946.
3. C. F. Burk, Oil and Gas Journal, October 12, 1946.
4. C. H. Caesar, Oil and Gas Journal, September 6, 1947.
   Petroleum Refiner, *26*, No. 10, 727(1947).
5. W. Flannigan, Ind. Eng. Chem., *39*, No. 1, 211(1947).
6. B. S. Greensfelder and H. H. Voge, Ind. Eng. Chem., *37*, No. 6, 514(1945).
7. B. S. Greensfelder and H. H. Voge, Ind. Eng. Chem., *37*, No. 11, 1038(1945).
8. C. L. Thomas, Ind. Eng. Chem., *37*, 543-(1945).
9. G. M. Good, H. H. Voge, B. S. Greensfelder, Ind. Eng. Chem., *38*, No. 10, 1033(1946).

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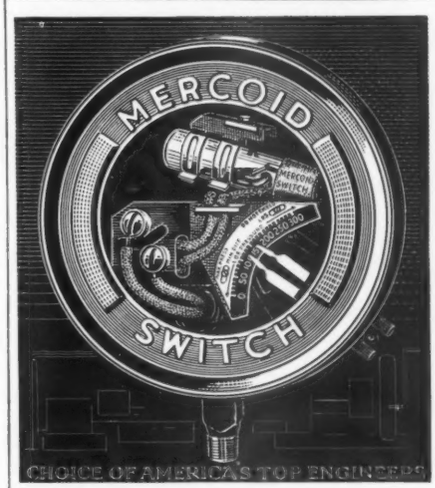

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THE MERCOID CORPORATION
4201 BELMONT AVE. CHICAGO 41, ILL.

Part 2

Life and Death in an Oil Refinery

P. M. VAN ARSDELL

PUMPING and distribution of hydrocarbon products to the various refinery areas present certain types of hazards. Pump operators are subjected to the danger of falling and to considerable dry heat[120] with widely varying temperature fluctuations as they move to different sections of the working area. There should be no danger from toxic vapors except in the event of equipment failures, leaks, and the like.

The physical conditions of the pump house are an important factor in the safety and well-being of the operators. Adequate ventilation at heights and near the floor both for dispelling the heat and heavy vapor is essential to prevent untoward physical reactions to heat and to the toxic effects of hydrocarbon vapors from previously described leaks which are considerably enhanced by heat.[98]

Heat Reactions

Since high heat is probably the greatest environmental hazard[13] under normal operating conditions in pumping areas, the following description may aid in recognizing the onset of certain physiological reactions and prevention of the more drastic effects from prolonged exposure to heat. The purely physiological effects of heat are of three types, each of which is dependent upon the physical state of the individual. The factors that predispose to ill effects from heat are chronic organic disease, inadequate sleep, overtiredness, old age, insufficient salt in the diet, dehydration of body tissues (excessive sweating), and alcoholism.[147]

One type of heat reaction, heat cramps, which is apt to manifest in new or inexperienced workers is characterized by convulsive muscular spasms that are quite painful. These develop after a period of muscle twitching and are followed by a seizure of painful spasms associated with abdominal colic, nausea, vomiting, and diarrhea. As the reaction progresses the worker becomes stuporous, and his pale skin is covered with sweat. Breathing is hampered by spasms of the diaphragm and of the muscles between the ribs. The pulse is rapid and strong, and the body temperature slightly above normal. The urine is scant due to excessive sweating. Heat cramps can be prevented by the use of salt tablets during the period of severe exertion in the hot environment, and the symptoms abated by rest and the use of salt to restore the severe salt imbalance caused by excessive perspiration.[147] In addition to those men working in high temperature environment, any sudden, decided rise in climactic temperatures are prone to cause these manifestations until the body makes its adjustment to sudden changes.

Another type of reaction to high temperatures — heat prostration or heat exhaustion—comes from working in excessively high temperatures. It is characterized by collapse with consciousness maintained. The pale skin is covered with cold sweat. The blood pressure is low and the heart rate less than 100 per minute; the pulse is feeble. The body temperature is nearly normal, and the respiration rapid and shallow. First aid consists of laying the patient flat with the head low, and keeping the body warm. A physician should be summoned to carry out further treatment. Preventive measures consist of drinking plenty of water and taking salt tablets. The avoidance of the predisposing factors is also helpful.[24, 147]

Canister type Willson gas mask for chlorine gas protection.

Heat stroke, sun stroke, or thermic fever is by far the most dangerous of all heat reactions, and is more apt to occur in older persons. The onset of acute symptoms is usually preceded by partial or complete cessation of sweating, indicating a breakdown of the heat regulating mechanism of the body. Headache, dizziness, fainting, and abdominal distress are the warning signals. Delirium and coma may develop in those severely affected and the chances of recovery are slim. Temperatures as high as 110 F have been reported; and whenever the rectal temperature exceeds 106 F the outcome is usually fatal. Profound shock, convulsions, and circulatory collapse precede death. The death rate from heat stroke may be as high as 50 per cent. First aid consists of removing the victim to a cool area and taking off as much of his clothing as possible. A doctor should be summoned promptly, and until his arrival, the body should be sponged with cold water until consciousness is regained. Then all the cool water the patient will drink should be given. Under no circumstances should stimulants be given.[24, 147]

Processing

The processing division of the refinery may be either quite simple or highly complex depending upon the variety of products made. The simplest operation is distillation, and the most complex rivals a chemical plant in charging materials, catalysts, and products. In recent years processing has tended toward the latter, and the hazards have increased with the complexity. Most plants have a variety of processes; the exposure reactions to catalysts and products deserve attention.

Is is recognized thoroughly that all mateials after they enter the process

areas are in closed systems wherever and whenever feasible. There are, however, numerous circumstances, such as equipment failure, leaks and the like, under which it is possible to contact the charging materials, catalysts, or products.

There are three avenues of entry into the body: inhalation, body surface contacts, and swallowing. Usually in processing areas the first two are most important, although occasionally accidental swallowing occurs.[14] Whatever the avenue of absorption, there are three types of reaction depending upon the degree of concentration of materials entering the body, and the nature of the material. The acute reaction usually occurs from exposure to high concentrations of toxic material. The onset of symptoms is rapid and pronounced, with quick termination that may be fatal. The cumulative reaction is one in which the toxic material builds in concentration in the body, and even though the initial exposure may not be noticed, the accumulation of the material may lead to the acute reaction. The chronic reaction, in contrast to the other types, is of long duration with only minor discomfort in comparison to them; however, the chronic reaction may persist long after the individual is removed from the offending environment. In order to avert either the cumulative or chronic type of poisoning it is well to insist upon periodic medical examinations with urine and blood tests for all workers in the processing areas so that any individual exhibiting signs of either the chronic or cumulative type of poisoning may be given adequate protection even to shifting to a less trying environment.

Distillation

Crude oil in its original state contains many varieties of hydrocarbons with diverse boiling points. In the early days of petroleum processing the major activity of refining was the simple separation of the hydrocarbons by distillation into different "cuts." Table 3 shows the various fractions, their boiling points, and approximate empirical molecular content.

The hydrocarbon structures present in each cut whether aliphatic or alicyclic depend upon the type of crude oil, if a primary separation; or upon the process used, if the distillation is a final product separation. The primary distillates from crude oil may also contain some sulphur compounds such as mercaptans, sulphides, or disulphides that should be removed whether they are to be marketed or rerun.[149]

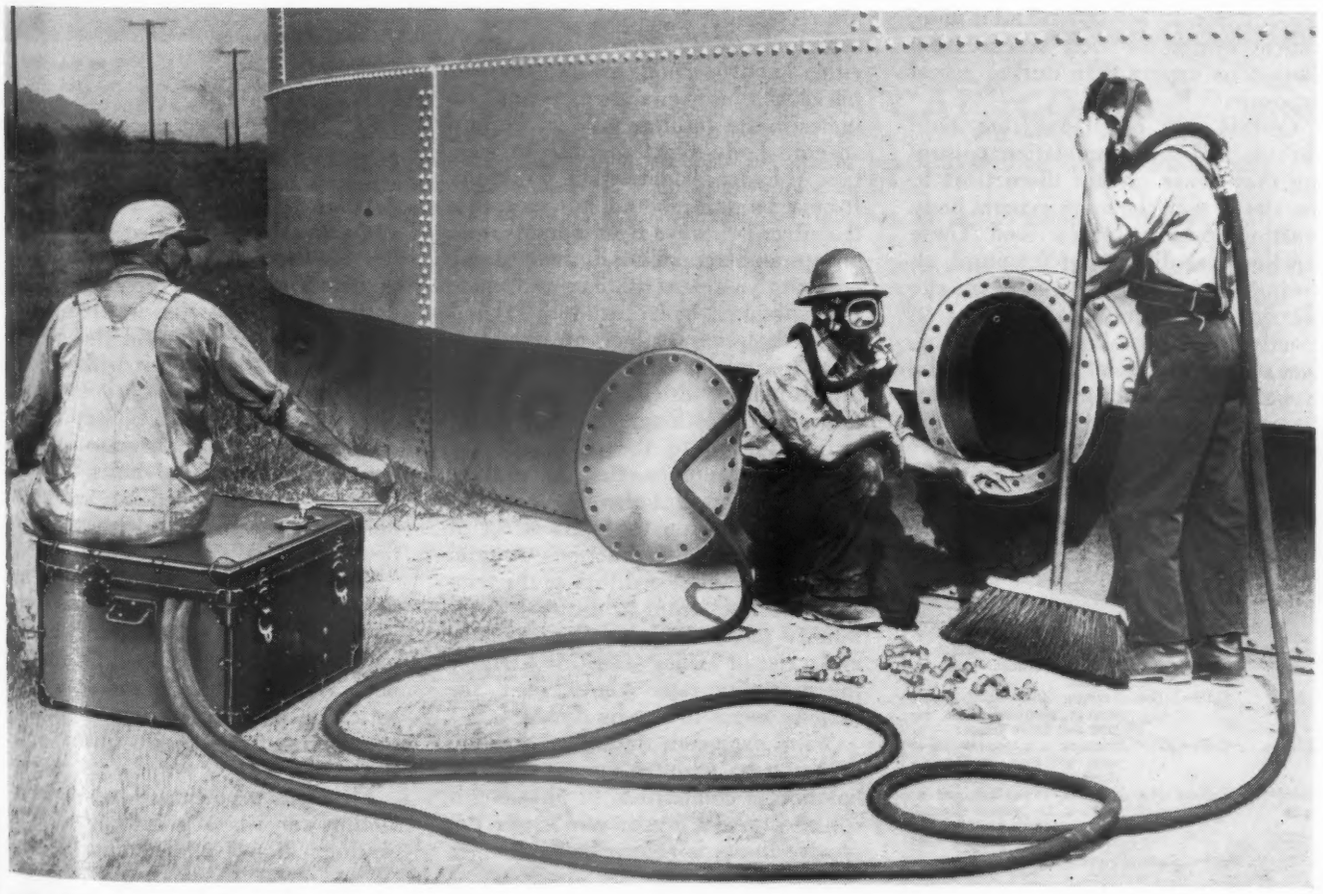
TABLE 3.

Compound	Boiling Point F	Main Constituents
Petroleum ether..	68–140	C_5–C_6
Petroleum benzine	104–194	C_5–C_7
Naphtha.....	149–248	C_6–C_8
Benzine.....	230–302	C_8–C_9
Gasoline.....	10% below 150 90% below 400	C_5–C_{10} and higher
Kerosine.....	300–580	C^8–C_{16}
Gas oil.....	400–700	C_{11}–C_{24} and higher

Up to and including the kerosine fraction, from whatever source, the initial effects upon the body from inhalation are much the same. The effects generally produced by inhalation are anesthesia (total or partial insensibility) and narcosis (unconsciousness). Skin contacts produce drying and defatting and clogging of the pores leading to cracking and secondary infections and may sensitize the entire body.[30]

Inhalation of hydrocarbon vapors accounted for four deaths from 1938 to 1947. Gasoline vapors (C_5-C_{10}) on severe exposures produce acute toxic effects,[46] manifesting as intoxication, narcosis, and depression of the central nervous system. Unconsciousness followed by delirium with bluish tinge to the skin, shallow breathing or stertorous, with thready pulse are

Combination hose mask and air supply assembly, as employed by workmen entering tanks containing hydrocarbon gases.



characteristic and pronounced effects for inhalation of this fraction. Headache, dizziness, nausea, vomiting, cough, weakness of the heart, muscular twitching, staggering and drowsiness are all typical of the so-called "hydrocarbon jag."[142] As the vapor-air concentrations rise, the symptoms are more and more pronounced, and with high concentrations, around 2.4 per cent in air[107] death may result.[13, 79]

In less severe forms a mild intoxication of the central nervous system leads to restlessness and excitement with rapid, irrational and incoherent speech, flushed face, rapid pulse, some amnesia, and loss of eye muscle control causing rolling of the eyeballs.[84, 102] Over a long period of inhalation in concentrations lower than those causing the acute symptoms, chronic depression of the nervous system is prevalent, although there is no cumulative indication. This is characterized by extreme weariness, sleepiness, heaviness in the head, ringing in the ears, tremor of the tongue and hands, and loss of the sensation of pressure.[89, 107]

As an after effect of acute poisoning—upon recovery in fresh air, the victim may be extremely irritable with a violent headache. Speech disturbances, bluish color, vomiting, or diarrhea, loss of sensitivity, and inflammation of the mucous tissues of the eye and bronchial area are fairly common. Many times the victim of acute poisoning seems to exhibit more violent symptoms after rescue from dangerous vapors than during actual exposure.[46, 69]

Certain eye reactions from both chronic and acute inhalation poisoning may cause greater discomfort to the victim than the more general body reactions previously described. These reactions are dilation of the pupil, allowing too much light to enter the eye blurring vision, irritation of the conjunctiva with a blood-shot appearance, uncontrollable rolling of the eyeball, and as a chronic disorder, inflammation of the orbital part of the optic nerve.[102, 146]

A number of chemical compounds are responsible for the predominating symptoms on gasoline inhalation. As either hydrocarbon group, that is, paraffins, olefins, naphthenes predominates in the gasoline product, certain specific body reactions due to each type of hydrocarbon will be produced. It must be remembered, however, that the effect is always from a mixture of groups and compounds and not to any one singly, unless the cuts are made for individual hydrocarbons. Table 4 shows the general effects of each class of hydrocarbons with the exception of the aromatics, which will be discussed under hydroforming.[42, 83, 141]

TABLE 4.

Class	Formulae	Effects
Paraffins....	C_5H_{12}–$C_{10}H_{22}$	Anesthetic and irritating, with dizziness, emotional disturbance, and muscular twitching. Narcotic effects increase as length of straight chain increases.
Olefins.....	C_4H_8–$C_{10}H_{20}$	Narcotic and toxic, muscle cramps, paralysis of respiration and heart action.
Diolefins....	C_4H_6–C_5G_8	Irritating to mucous tissues of nose and eyes, anemia-producing on long contact.
Naphthenes	C_5H_{10}–C_8H_{16}	Narcotic, nauseating, and irritating to mucous tissues; causes staggering with convulsions preceding death. (29),(96)

Tank gauger's mask, used by personnel where exposed to hydrocarbon or lethal gases such as hydrogen sulphide. Mine safety appliance.

In addition to the effects of the chemical groupings, the temperature of the environment also has a considerable bearing on the toxic effect of gasoline and higher fractions. Animal studies have disclosed that as the temperature rises from 62 F to 67 F the fatality rate from inhalation doubles, and a rise of 11 deg (62F-73F) triples the mortality rate. Above 73 F the toxicity seems to remain fixed.[98]

With explosion fatalities actually higher from gasoline vapors than inhalation, a comparison of physiological effects with upper and lower explosive limits is shown in Table 5.[114]

TABLE 5.

Gasoline and its effects	% by volume in air
Lower explosive limit.....	1.4
Upper explosive limit.....	6.0
Odor can be identified.....	0.03
Dizziness in 14.5 min.....	0.07–0.28
Dizziness in 3.0 min.....	1.13–2.22
Dizziness in 10–12 breaths.....	2.2–2.6

As gasoline vapor is 3 to 4 times heavier than air, by the time the odor is detectable to an erect man, the danger from explosion is already considerable. The odor and the physiological effects increase with the increasing number of carbon atoms. The odor of C_6 and C_7 vapors are easily detected in concentrations below their flammable limits, but C_3, C_4, and C_5 are practically undetectable by odor in the lower explosive limit mixtures.[119]

As the molecular weight of the hydrocarbons increases in the kerosine, gas oil, and fuel oil fractions, the inhalation hazard decreases. This fact is not primarily due to the less toxic action of the hydrocarbon compounds present, but to their lower volatility.[157]

First aid procedure for inhalation victims consists of removing to fresh air immediately and calling the doc-

N.B. While it is axiomatic that return on investment—the *ultimate earning power* of a refinery unit when actually on stream—is the only true evaluation of competitive engineering recommendations, initial plant costs remain a major factor in refiners' decisions on plant installations. M. W. Kellogg takes specific steps to *minimize initial plant costs* consistent with the achievement of *highest ultimate earning power.*

HOW A GIANT BENDER LOWERS "CAT" COSTS

In today's huge *Fluid* cat-crackers, catalyst lines are a transportation system for the equivalent of some 600 freight cars of material every 24 hour period. Fabrication of pipe big enough to handle this job (up to 60 inches in diameter) has always been time-consuming and expensive.

First, the curved pipe has always been tediously formed by welding together several, carefully-mitered sections. And then, the resulting irregular contour required the field-installation of wear plates to absorb erosion during on-stream periods.

To accomplish fabrication economies in this important part of the modern "cat", Kellogg's mechanical and metallurgical specialists produced something that had never been made before. They made *continuous one-piece* bends—in diameters up to 96 inches—by creating an *exclusive pipe-bending machine.*

All latitudinal welding, all special mitering is eliminated. In addition, because the insides of these new bends are smooth and in a continuous arc, wear plates are unnecessary . . . reducing field labor on just this one refinery part *by more than 50%.*

Thus the giant bender brings *initial savings* in addition to long-term protection . . . providing improved operating characteristics, radically lower maintenance costs and a reduction in down-time during turn-arounds.

This accomplishment could result only from pooling the talents and knowledge of an *integrated* organization, such as Kellogg, which includes fully-staffed groups versed in all phases of refining engineering, equipment fabrication and plant construction. Savings shown in this case history reflect only a small part of the overall opportunity for lowering costs, but they do emphasize that *completeness and integration* of the engineer-contractor are the soundest approach to LOW INITIAL PLANT COSTS.

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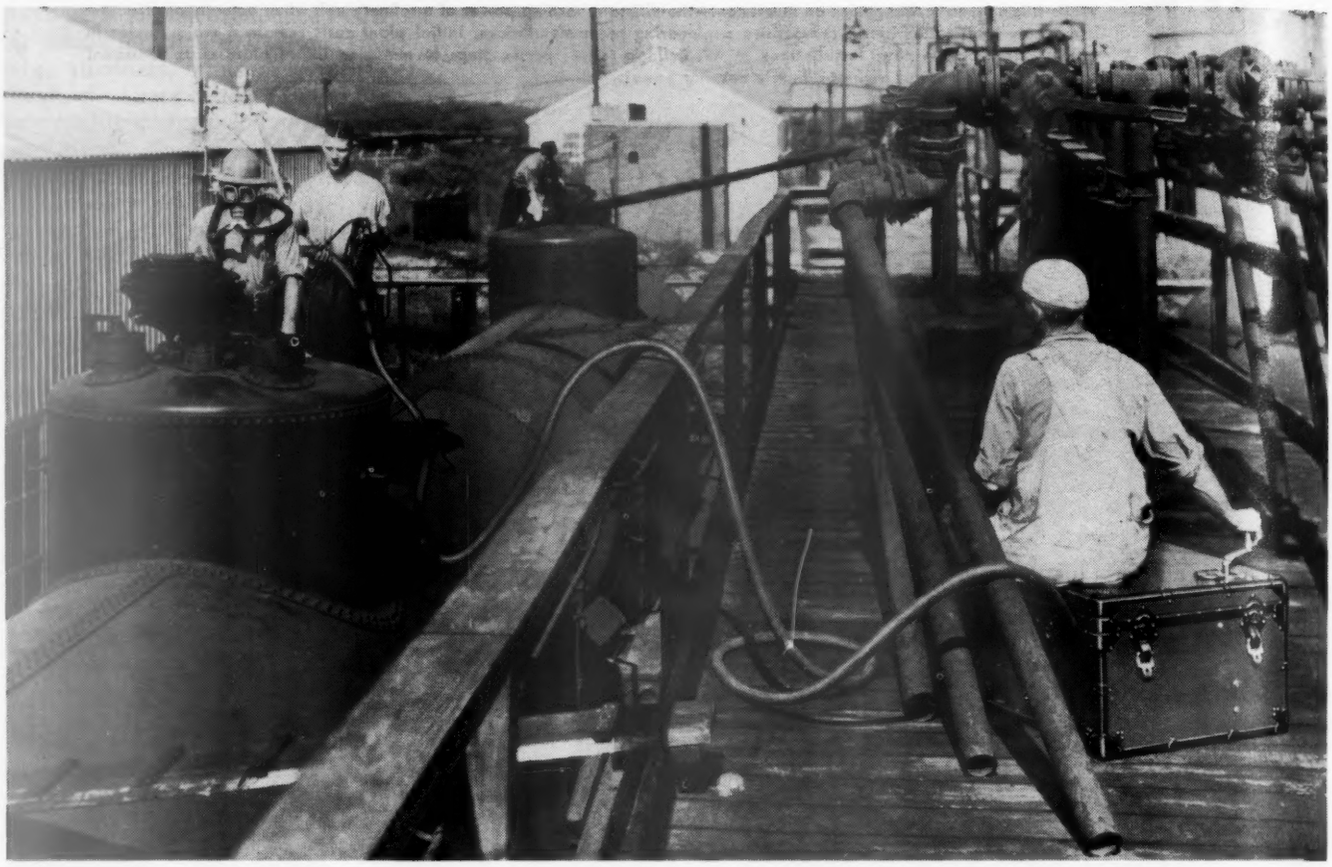

M.S.A. combination hose mask employed by workmen entering a tank car.

tor. If the patient is unconscious and breathing is stopped, artificial respiration (prone pressure) should be given until the doctor arrives or until breathing is restored. The person should be kept warm and at rest, since bronchitis or pneumonia may develop as a result of inhalation.[157]

All fractions produce a number of skin reactions, the severity of which increases as the molecular weight of the fractions increases. This is probably due to the impurities present in the heavier fractions as there is no evidence of skin reactions to refined mineral oil.[58, 137]

The following skin reactions are caused by the various oil fractions.[151]

Gasoline—(B.P. 300 F and below) superficial dermatitis, dry scaly skin, eczema with fine blisters, pimples, and pustules.

Burning Oils—(B.P. 300-570 F) pimply, pus forming eczema, small numerous lesions at the hair follicles, acne, and abscesses.

Residues—(B.P. above 570 F) redness, premature aging of the skin, characterized by horny layers on the backs of the hands and forearms,[127] warts, ulcers, and conditions that may lead to skin cancer.

"Refiner's itch" has also been reported.[58]

The lower or lighter fractions tend to dry and defat the skin, and the higher fractions clog the pores and seal in any bacteria present on the skin. Proper observance of personal cleanliness can aid in preventing many of the skin reactions. When contact is made, the area should be washed thoroughly with soap and water, and a heavy lanolin ointment applied to restore some of the lost skin lubrication. If discomfort persists, or any boils or pimples appear, a doctor should be consulted. Neoprene gloves and aprons should be worn whenever any fraction or residue is contacted.

Only on rare occasions such as leakage is it possible for accidental swallowing[14] or splashing into the mouth.[125] The lower fractions, gasoline, kerosine, and lower, on swallowing cause vomiting, stomach pains, difficulty in swallowing, fever, bronchial symptoms, kidney and digestive disturbances.[107]

First aid consists of inducing vomiting, if not present, as soon as possible, or stomach lavage, and the administration of a laxative dose (1 tablespoonful) of Epsom salts in hot water. A doctor should be summoned promptly.

With regard to water contamination, it is general practice not to connect a line carrying products under pressure in any manner to drinking water lines, regardless of block valves. This has now become the rule in all manufacturing plants. The water pressure cannot be depended upon to remain up, nor the product pressure to remain constant. It is impossible to place complete dependence upon the human equation to keep them closed.[14]

Bibliography

26. Anon. *Journal American Medical Association* (Belgian Letter) *109* 1922 (1937).
27. Anon. *Journal American Medical Association*, Queries and Minor Notes, *111* 273 (1938).
28. Anon. *Journal American Medical Association*, Queries and Minor Notes, *112* 1749 (1939).
29. Anon. *Journal American Medical Association*, Queries and Minor Notes, *113* 1900 (1939).
30. Anon. *Journal American Medical Association*, Queries and Minor Notes, *116* 2450 (1941).
31. Anon. *Journal American Medical Association*, Queries and Minor Notes, *118* 337 (1942).
32. Anon. *Oil and Gas Journal*, *45*, No. 46, 150 (1947).
33. Anon. Soc. chim. France, Sec. Toulouse, proc. June 19, 1937, from Pharm. Abs. V, 25, (1939).
34. Anon. "Sulfuric Acid" Controlling Chemical Hazards, Ser. 4, U. S. Department of Labor, Bureau of Labor Standards, Washington, D. C. (1946).
35. Armistead, Jr., G., "Desalting Petroleum Oils," *Oil and Gas Journal*, March 23, 1946.
36. Armistead, Jr., G., *Oil and Gas Journal*, p. 97, April 13, 1946.
37. Armistead, Jr., G., "Safety Inspection," *Oil and Gas Journal*, April 20, 1946.
38. Armistead, Jr., G., "Hydroforming Process," *Oil and Gas Journal*, August 31, 1946.
39. Barillet, F. L'Industrie Chimique, *29*, No. 332, 80 (1942).
40. Beauchamp, M. L., *California Safety News*, *31*, No. 1, 13, (1947).
41. Benson, R.G., Ind. Medicine, *13*, 113 (1944).
42. Benson, R. G., and Van Arsdell, P. M., *Oil and Gas Journal*, *45*, No. 15, 95 (1946).
43. Bigg, E., Jennings, B. H., and Olson, F. C. W., *American Journal Public Health*, *35*, No. 8, 788 (1945).
44. Boggess, H W., *Oil and Gas Journal*, p. 81, November 2, 1946.

(Part 3 will be published soon)

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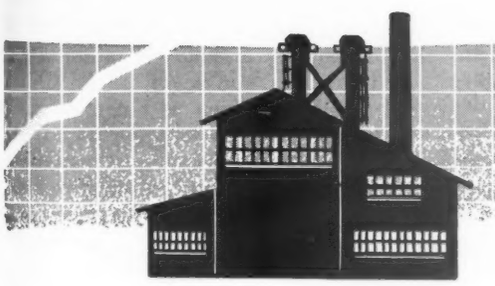

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Technologists Discuss Progress in Oil Shale

RICHARD SNEDDON*

CONSIDERABLE excitement was created among California oil men by a recent panel discussion on the general subject of oil shale. The affair was conducted under the auspices of American Institute of Mining and Metallurgical Engineers, and featured a battery of experts from Union Oil Company of California; A. C. Rubel, vice president; Tell Ertl, mining engineer; Clyde Berg, supervisor of process development; and Homer Reed, chief engineer in the manufacturing department. Moderator of the discussion was W. H. Geis, consultant, and under his direction the entire shale picture in all its phases was unfolded in a lucid and informative manner. Geis himself gave an interesting dissertation on the genesis of oil shale, which helped to round out an illuminating session.

As the opening speaker, A. C. Rubel pointed out that no rational person would advocate the institution of a synthetic fuel industry at the present time. What with our own high production capacity of petroleum, and such additional sources as Canada, Mexico, Venezuela, and the Middle East from which to draw, we seem to have ample reserves for some time to come. It appears obvious, however, that on the basis of estimated future demand, particularly for "middle of the barrel" products, that is, diesel and distillates, and projected future production, we are not going to be able to build up very substantial reserves against the possibility of an extended emergency.

Past experience has shown that in war times we cannot depend on foreign fields for such surplus as we might need; accelerated drilling is no longer sufficiently productive, and stock piling is too expensive and too vulnerable. Actually a program of preparedness involving exploration of synthetic fuels seems to be our most promising security measure. This does not mean the institution of a shale oil industry operating in competition with petroleum, but it does imply the establishment of ways and means of producing and refining shale oil, so that we need not work them all out after the emergency has arrived.

Financing

It has been suggested that the proper government agency finance and that private industry build and operate, a shale mine producing 12,000 tons a day, complete with a retorting plant to recover the oil and a refinery capable of rendering usable some 8000 bbl of shale oil per day. The size is thus defined to assure development on a "commercially feasible" scale; in other words, to so advance the entire program that if and when a need arises, we shall be in a position to supplement our fuel supply immediately with shale oil products. Speaker Rubel was very emphatic in his reiterated admonitions that the program be regarded as a species of insurance against unreliable foreign sources rather than a new industry to compete with petroleum in the open market.

In general, shale retorting studies in this country have not gone beyond the pilot plant stage, and insufficient data are available on which to base production costs, but A. C. Rubel gave it as his opinion that on a 100,000 bbl a day basis, material "equivalent to the best of our high grade refining crudes" could be produced at a cost "favorably competitive with natural crudes at present prices." This fact he attributed to the specific methods of mining, retorting, and refining, later to be described by other speakers. Another important consideration is that oil shale finding costs are practically nil, while exploration costs are a sizable item in petroleum production expense.

The speaker further indicated that oil shale operations in a demonstration plant big enough to yield 100,000 bbl a day of product would necessitate an investment of approximately $200,000,000, not including the cost of pipe lines to marketing centers. And although no existing condition warrants any such outlay at present, once its commercial feasibility has been demonstrated, the money would soon become available as "a sound business investment." From such a demonstration plant ultimate yield would be diesel oil, jet fuels, and high gravity, sulphur-free charging stocks, all of which could be sold to military establishments, to other refineries, and to utility companies, and in this manner could recover the original investment in about 10 years.

Discussing methods of mining Colorado oil shale, Tell Ertl first defined its character and source, drawing particular attention to the facts that it is neither shale, nor does it contain oil. Actually it is a composite of calcium and magnesium carbonates, clay materials, and other solids of an organic nature from which an oil can be distilled. It occurs in the Piceance Creek basin of northwestern Colorado—a pleteau that is underlain by a shale bed about 1000 ft thick, the middle of 50 to 100 ft of which is known as the mahogany ledge, and assays roughly 25 gal per ton. The mahogany ledge alone is believed to be capable of yielding 100 billion barrels of shale oil.

Rich Shale Bed

Building a road to the working face in Union's property in this area was no easy task. The plateau towers steeply to 2500 ft above the valley floor. At the upper end of the road is a landing to accommodate housing and equipment. Operations consist essentially of breaking, loading, and transporting the shale. These of course are amplified by such needs as lighting, ventilation, dewatering, and the installation of supports in the workings. Overburden above the mahogany ledge being from 300 to 100 ft thick, it was both economical and advisable to mine horizontally. Oil shale is strong, able to support its own weight over 100-ft spans, and is mined safely from a large room with the aid of vertical supports 60 ft square and spaced 60 ft apart.

The shale is loosened by drilling a shot hole, charging it with explosive, and then detonating the latter. A completely satisfactory method of drilling, according to Ertl remains to be found, despite 5 years of experimentation. Oil shales vary in strength but in general, compression strength is about 15,000 psi; shear strength, 6000 psi, and tensile strength, 2000

*Pacific Coast Editor.

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psi, five times that of concrete. From which it would appear that rotary drilling should produce the best results. Experimentation finally led to the use of percussion drilling, with which penetration speeds ranging from 1 to 2 ft per minute have been achieved. Greater efficiency is obtained by mounting 4 drills on a special carriage, designed to furnish maximum penetration time. Rotary drilling research still goes on, and Dr. Ertl was optimistic that the near future would see improvement in the present methods.

When the holes are drilled in the mine face in the proper pattern they are usually charged with a 45 per cent semiammonium gelatine dynamite. After the rock is broken by the firing of this charge, a large loader—a three-yard electric shovel—is employed to carry the rock to the crushing plant. Crushing does not present any great problem, since much experience has already been gained in other types of mining, and the involved factors are pretty well understood. Demonstration mining performed by the Bureau of Mines, together with other pertinent data, indicates that oil shale can be mined, crushed, and transported to the retorts for less than 60 cents per ton.

Clyde Berg explained the operation of Union Oil Company's revolutionary new shale retorting plant, which seems to have brought shale oil extraction to some semblance of economic rationality. Prior methods were estimated to cost an average of $2 a barrel. Union's method consists of a kiln with continuous bottom feed of solids running countercurrent to a flow of shale oil and air. Ash and clinker are removed overhead, and oil drains off at the bottom. The burning of residual carbon in the shale clinker at the top of the kiln creates a downward heat flow that distils the oil, and an almost perfect heat exchange takes place as the incoming air is heated by the spent clinker, and the cold shale entering at the bottom acts as a condensing medium. Available heat in stack gases far exceeds plant requirements.

Union Shale Retort

Examination of prior methods showed that indirect heat exchange was inefficient and costly—often necessitating initial capital investments as high as $3000 a barrel of daily capacity. As employed in Union's method, direct heat exchange between the high temperature flue gas used for retorting and the cold incoming shale is especially effective because of the large area of surface presented by the shale. Also, since the shale itself is the cooling medium, no extraneous utilities are needed. The carbon that remains on the shale after retorting becomes a fuel both for continuance of the retorting process and for other outside uses. Its energy is recovered in available form by the producer gas operation, and along with the fixed gases emanating from the distillation process, constitutes a substantial auxiliary fuel supply.

(See Petroleum Engineer, December, 1948, page 214, for description of this kiln and its operation.—Ed.)

The entire operation of the kiln is automatic, including the control of airflow, the burning level, and the feed rate. There are three distinct zones of action in the retorting section, as follows: Top—in which heat is exchanged between incoming air and hot clinker. In the lower portion of this top section clinker carbon is burned, producing flue gases with a temperature approaching 2000 F. In the second zone oil is volatilized, the mixture of vapors and flue gas traveling downward into the third zone. Here condensation takes place and the incoming shale is heated. The temperature of the oil leaving the kiln is within 20 F of the temperature of the incoming shale.

Ash fusion is no problem in this retort, as in those in which the charge travels downward by gravity. Removal is in this instance mechanically contrived and is effective. Oil mists which commonly appear in the gases drawn from the base of the unit—in varying quantity according to the character of the charge—are agglomerated and collected thoroughly by the apparatus already mentioned.

Refining Is Practicable

The refining of the shale oil was discussed very ably by Homer Reed, who first noted that the peculiar character of shale oil precluded the use of available refining methods, at least until they had undergone considerable adaptation. He intimated, however, that on the basis of already proven procedures, shale oil can be refined on a large scale to yield high grade products equivalent — in some cases even superior — to petroleum derivatives. Oil, it was remarked, does not exist in the shale as such, but as an organic substance called kerogen. Under the influence of heat this kerogen is decomposed and distilled as shale oil. Thus, shale oil itself is a cracked distillate, highly reactive because of its unsaturation. Kerogen has a composition somewhat as follows:

Carbon	69.7 per cent
Hydrogen	10.0 per cent
Oxygen	15.9 per cent
Nitrogen	3.1 per cent
Sulphur	1.3 per cent

The successive steps now deemed necessary by Union Oil Company to convert this shale oil into usable commodities are:

1. Conversion of raw shale oil as fully as possible to a product having the boiling limits of good vaporizable fuel. This it is proposed to do by recycle coking; increasing the volatility by thermal cracking, and at the same time reducing the C-H ratio by coking out carbon, and depressing the pour point of the oil.

2. Elimination of high nitrogen, sulphur, and oxygen, and high reactivity, by hydrogenation. Union has developed a moderate pressure catalytic hydrogenation pilot plant which has been successful in accomplishing the desired results.

The yield of 750 F end point coker distillate is in the neighborhood of 86.7 per cent by volume, or 80.0 per cent by weight. The gas and coke formed in the operation help appreciably to offset the yield deficit. It may be remarked also that both the steam and hydrocarbon gases that constitute the feed to the hydrogenation plant, are byproducts of the coking operation.

Hydrogen is generated by the common steam-hydrocarbon gas reaction, and the process selectively converts the unwanted components to NH_3, H_2S, and H_2O, without the necessity of removing the hydrocarbon molecules in which they exist, as would have to be done, for instance, in solvent extraction. At the same time the addition of hydrogen produces a greater degree of saturation, hence greater stability of the shale oil. The final hydrogenated coker distillate is about equivalent to a straight-run diesel oil — and — lighter fraction from a good petroleum crude. Incidentally, the NNH_3 may be removed either as a gas or as ammonium sulphate, $(NH_4)_2SO_4$, and results indicate that for every 1000 bbl of shale oil refined, about 2½ tons of ammomia, NH_3 are produced.

In *toto*, the speaker was of the opinion that no great difficulties were to be foreseen in refining shale oil. The coking unit, hydrogen generator, and fractionation equipment, are typical industry tools, and their adaptation to this new purpose would be comparatively simple. The hydrogenation process described is a Union Oil Company development. It has not been tested commercially but the use of moderate pressures makes it particularly attractive. Commercial hydrogenation units have hitherto employed pressures as high as 10,000 psig.

* * *

NEWS

Develops New Process For Production of Gas

The Autothermic Cracking Process for the production of gas for supplementary supplies of fuel gas, and for cracking hydrocarbons to make ethylene and other olefin gases is announced by Universal Oil Products Company. The process is reportedly highly flexible in its operation and choice of charge stocks for various purposes. It cracks or reforms propane, naphtha, natural gasoline, cr hydrocarbons mixed with air, which may be controlled to produce gas similar in properties to that regularly supplied by gas companies from other sources for their customers. A Universal research chemical engineer started with the basic idea of cracking in the presence of air. Air and hydrocarbon streams are preheated separately and mixed for reaction in an insulated vessel, in which the heat efficiency is reported to be 98 per cent. The same unit may be used for producing olefins also, by varying conditions.

Builds New Refinery

Imposing stacks and distillation towers are rising above the flat, sage-covered area a few miles north of Salt Lake City, site of the Salt Lake Refining Company's new $5,000,000 refinery at the base of the Wasatch Range.

Lying at the terminus of a 182-mile pipe line from Rangely, Colorado, the refinery will handle an estimated 25,000 bbl of crude oil per day.

Engineers constructing drainage, run-off and sewage installations encountered the problem of laying pipe in soil containing excessive alkali content, and installing a sewer system capable of resisting deterioration and corrosion from acid in the waste discharged from refining processes.

Although industrial waste will be run through a separator and neutralized before the effluent is emptied into disposal lines, vitrified clay pipe totaling 8700 ft for industrial and sanitary sewers, ranging from 4-in. to 21-in. diam was specified for its acid and alkali-resistant properties.

The plant was designed under supervision of the Standard Oil Companies of California's engineering department. It was constructed by the Bechtel Corporation.

Arkansas Chemical Plant Nears Completion

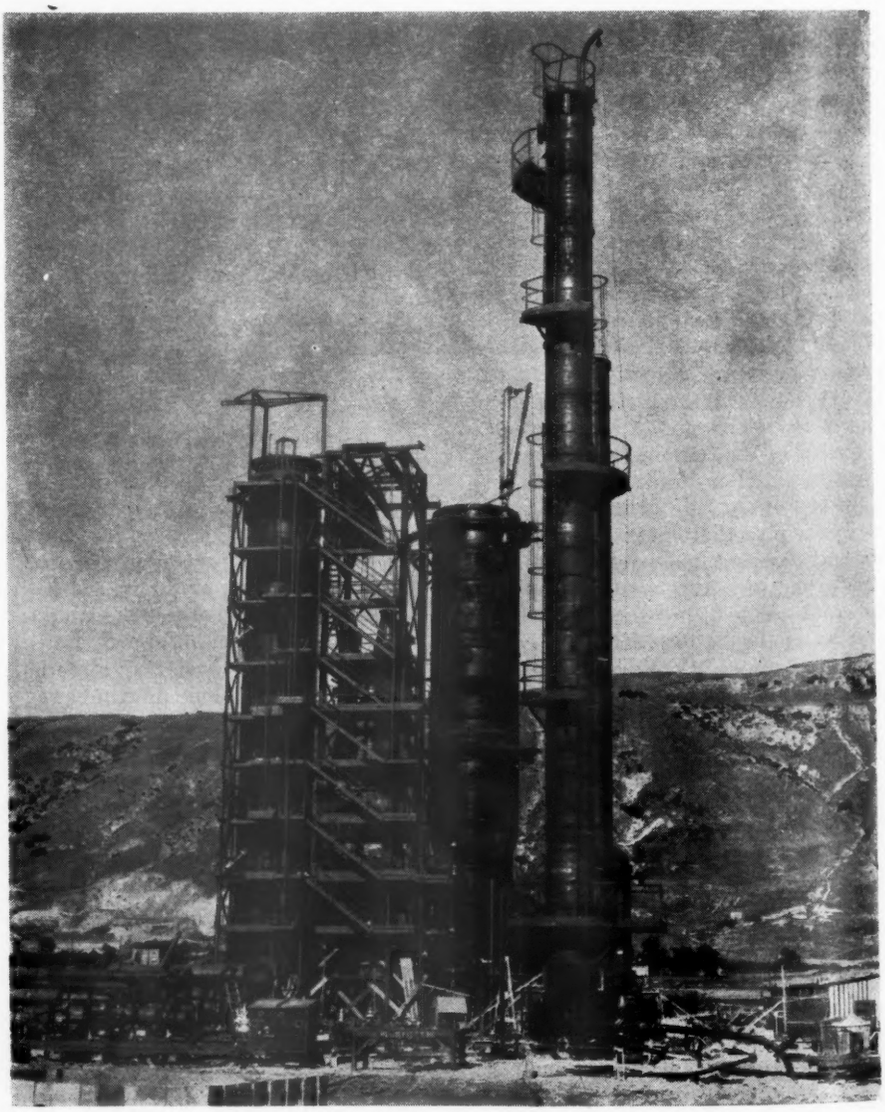
The 1948 capital expansion program launched by the Lion Oil Company at its chemical plant at El Dorado, Arkansas, involving the expenditures of approximately $6,500,000 is scheduled for completion this year. This program provided for a 30 per cent expansion of existing ammonia producing facilities, the alteration and expansion of the ammonium nitrate graining plant, and the provision of plants for the manufacture of sulphuric acid and sulphate of ammonia.

Great strides have been made in the mechanization of agricultural operations and in the adoption of approved fertilizer practices. Due to the rapidity with which nutrient elements are leached from the soils of the South, the correct use of fertilizers is of basic importance to the southern farmer in securing adequate crop yields.

The maintenance of life as we know it is dependent upon our ability to convert atmospheric nitrogen to a form in which it can be utilized directly by plants. Without such conversion the nitrates present in the soil would soon become exhausted and plant life would disappear. As higher forms of life depend upon plants for their source of nitrogen they, too, would vanish. Based on these considerations, Huxley, the great English economist, predicted in 1887 that all life on the world would become extinct in fifty years due to the exhaustion of all available supplies of fixed nitrogen. That this dire prediction did not come true is due to the development of commercial processes for the fixation of atmospheric nitrogen.

The first synthetic nitrogen plant employing the Haber process, in which nitrogen and hydrogen are combined at high pressures to form ammonia, was constructed at Oppau, Germany, in 1912. The operation was so successful that by 1935 the number of plants had increased to 111, located in all parts of the world.

In 1940, the capacity of the nine synthetic nitrogen plants in the United States was approximately 390,000 tons. During the war, the government



Stacks and distillation towers near completion at site of Salt Lake Refining's $5,000,000 project sewered throughout with clay pipe. Wasateh Range appears in background.

constructed ten synthetic ammonia plants with an annual capacity of 797,000 tons, while the capacity of private synthetic ammonia plants was increased by 41,000 tons. The total production of synthetic ammonia in the United States by 1950 is expected to be 1½ million tons.

Lion entered the ammonia field in 1943 as the operator of the Ozark Ordinance Works at El Dorado for the government's account. This plant which has been in continuous operation since that time, was purchased by Lion in 1948. The average daily production during the past year was 444 tons of anhydrous ammonia, slightly more than 10 per cent of the total synthetic nitrogen produced in the United States.

Natural gas and air are the raw materials used by Lion for the manufacture of ammonia. The abundant supply of natural gas in the Southwest for both raw material and power requirements make this section an unusually desirable location for the production of synthetic ammonia. The location of the plant in the midst of a rich agricultural area also dictates, in large measure, the market for the product. A little over one quarter of the 162,663 tons of ammonia produced in 1948 by the Lion plant was sold as such for direct application to the soil, the remainder being utilized in the manufacture of 109,606 tons of a complete line of nitrogen fertilizer solutions and 125,844 tons of granulated ammonium nitrate fertilizer.

The sulphuric acid plant, scheduled to be completed this year, will produce 300 tons of acid per day. Substantially all of this production will be reacted with 100 tons of ammonia to produce 380 tons of sulphate of ammonia. Thus in 1949, Lion will be in a position to furnish a complete line of ammonia based fertilizers, including anhydrous ammonia and aqueous ammonia for direct application to the soil, nitrogen solutions for the manufacture of mixed fertilizers, ammonium nitrate for direct application, and sulphate of ammonia for both direct application and the manufacture of mixed goods.

Located in the heart of the deep south adjacent to one of the richest farming areas in the world, the Mississippi Delta, Lion has been able to contribute materially to the South's most important source of income, agriculture. Whenever agricultural demands for fixed nitrogen have been met, Lion is in a favorable position to expand into the industrial nitrogen field to meet the needs of the consuming industries in this most rapidly growing of all industrial areas.

Gas Compression Plant

Contract for construction of a 25,000,000 cu ft per day gas compression plant has been announced by R. D. Hanley, vice president of Magnolia Petroleum Company. Engineering of the project is being done by Magnolia and by Delta Engineering Corporation of Houston, Texas. The Construction Service Company of Houston is the general contractor for the job; the plant is to be located near Chitwood, Oklahoma, seven miles southwest of Alex, Oklahoma, and 14 miles northeast of Rush Springs. Construction has been started, and it is expected the unit will be completed in October, 1949.

A-1 engines and main items of equipment are already at the site. Units include four 880-hp Type GMV Cooper-Bessemer engine compressors that will handle up to 35,000,000 cu ft of gas, recovering liquid hydrocarbons therefrom and delivering the gas at a pressure of about 4600 psig.

Socony To Build TCC Units

Socony-Vacuum Oil Company, Inc., has made several new developments in the Thermofor Catalytic cracking process, in the original of which the company is very active, and will build four units to the new improved design, at its plants in Trenton, Michigan, Augusta, Kansas, and Beaumont, Texas, the company has announced. One unit each will be built at Trenton and Augusta, with two being installed at Magnolia Petroleum Company's refinery at Beaumont.

These new units will have a combined capacity of 60,000 bbl per day throughput, and will replace fixed-bed Houdry units, in operation at these plants for several years, it is stated.

Patton Refinery Fire

Approximately one-fourth of the $200,000 refinery and almost a million and a half gallons of oil and oil products were destroyed recently, when fire broke out in the Patton oil refinery in Rotan, Texas. The blaze started when an oil boiler exploded. A short-circuit in wiring was believed responsible. The explosion occurred as an employe threw a light switch.

Crankcase Oil Plant

Contracts have been signed by the Seminole, Oklahoma, Chamber of Commerce and the Oklahoma Refining Company in connection with construction of a plant at Seminole to refine crank case oil. Construction is to start at once on the plant which will have an initial production of 200 bbl a day and employ 15 persons. Stanley D. Belden is company president.

Acquire Larger Offices

As a result of expansion of its activities, Jefferson Chemical Company, Inc., has moved its executive and sales offices to new and larger quarters at 711 Fifth Avenue, New York.

Jefferson's plant at Port Neches, Texas, which was placed in production early in 1948, manufactures ethylene oxide, ethylene glycol, ethylene dichloride, and other ethylene-based chemicals. Jefferson is owned by American Cyanamid Company and The Texas Company.

Undergoes Shut-down

Work on the multi-million dollar modernization program at The Texas Company's West Tulsa, Oklahoma, refinery has been shut-down as a result of a walk-out about a month ago of pipe fitters employed by contractors.

It is understood work of other craftsmen employed by the contractors — the Foster Wheeler Company and M. W. Kellogg Company—could no longer be done without work being done by the pipe fitters. The pipe fitters walked off the job after they had asked for a wage increase.

Octane Rating Upped

Boosting of the minimum octane rating requirements for Ethyl grade premium gasoline to 86 by the ASTM research method of determination, has been announced by the Ethyl Corporation, effective on and after September 20, according to H. W. Kaley, vice president. Seven Rocky Mountain States, and the Panhandle area of Texas are exempted from this minimum, but must meet an 83 research octane rating standard, Kaley said.

This step marks the end of the last postwar shortage bottleneck. Because of excessive demands of the whole market, it has not been practicable for many refiners to meet the higher standard and the last move of Ethyl Corporation was to reverse their earlier action in raising octane requirements. Metallic lead is available now in amounts sufficient to permit manufacture of ample quantities of the anti-knock fluid.

The change in the requirement which utilizes the Research method for determination of octane rating and for predetermination of the performance of motor fuels on the road is significant, also. Until recent years the ASTM Motor Method was considered the better of the two methods, correlating more closely with actual car engine performance on the road. This attitude has changed and correlation of road octane numbers with those determined by the so-called Research Method is better than with the Motor Method numbers.

NEWS

Projects Near Completion

Three refinery improvement projects which will conserve natural resources and permit more efficient refinery operations are nearing completion at the General Petroleum Corporation's Torrance, California, refinery.

The projects, costing over $400,000 in all, are:

A 2,000,000 gal pressure storage vessel, to cut evaporation losses. A new cooling tower to make possible the recovery to a higher percentage of the valuable light hydrocarbons. A new chemical treating facility to make possible the recovery of approximately 2000 tons of lead annually.

The noded spheroid will be the largest pressure storage vessel and the only one of its design in the West. The vessel stands 50 ft high and 102 ft in diameter. Chicago Bridge and Iron Company fabricated and are erecting the spheroid which weighs approximately 375 tons. Completion is scheduled for July.

About 8400 additional gallons of valuable light petroleum fractions, all important components of high quality gasoline, will be recovered each day by the operation of the cooling tower, which stands 48 ft high and covers a 30-ft by 90-ft area. A total of 11,000 gal of water will be cooled an average of 28 deg each minute, releasing 150,000,000 BTU's hourly. The new chemical treating facility is designed to reclaim lead from "doctor solution."

Pacific Area Meeting

The American Society for Testing Materials will hold its first Pacific area meeting in San Francisco the week of October 10, 1949, according to announcement from the Philadelphia, Pennsylvania, headquarters of the society. The meeting will include 15 technical sessions and the presentation of 70 technical papers. These sessions include those on Petroleum I, High Additive Content Oils; Petroleum II, Turbine Oils; as well as separate meetings on bituminous paving mixtures, cement and concrete I and II, and two meets on paints. In addition, committee meetings will include those of D-2, Petroleum Products and Lubricants, D-4, Road and Paving Materials, and D-8, Bituminous Waterproofing and Roofing Materials. The general committee on arrangements is headed by Dozier Finley, research consultant, The Paraffine Companies, San Francisco. Meetings will be held at the Fairmount Hotel, and the petroleum sessions are scheduled for October 12.

Japan's Chemical and Petroleum Industry to Rebuild

The chemical processing and petroleum refining industries of Japan will be rebuilt as a result of a new contract entered into between Thomas Bryan and Associates, Inc., of Houston, Texas, and the Nippon Kihatsuyu Kabushiki Kaisha (Japan Gasoline Company, Ltd.), Thomas S. Bryan has announced. Masao Saneyoshi, president of the Japanese company, points out that practically all of that country's refining capacity was destroyed by bombing during the recent war. Considerable progress has been made, it is understood, in negotiations for the renewal of contracts with foreign oil companies for supplying the Japanese refineries with crude sufficient for their operation, and it is expected that present restrictions regarding the production of petroleum products in Japan will be lifted sometime in the not too distant future, by our GHQ in Japan.

Thomas S. Bryan

Reports connect such names as the Nippon Oil Company and the Caltex organization in current negotiations; also Showa Oil Company and Shell interests; Toa Fuel and Standard Oil Company; and Mitsubishi Oil and Tide Water Associated Oil Company. Expectation is that soon Japan will become a heavy importer of crude oil. If authorities permit Japan to produce petroleum products for export it is imperative that processes like catalytic cracking, etc., must be built immediately, on a relatively large scale. Under the direction of A. C. Atwater, Bryan's Chemical and Petroleum Division manager, plans and designs are going forward on fatty oil refineries, margarine, alcohol and sorbital plants, and factories for soaps, paints and synthetic resins to meet Japan's domestic and export requirements.

Survey Aviation Gasoline

A report on January, 1949 production of 74 samples of commercial aviation gasoline has been issued by the U. S. Bureau of Mines as "R. I. 4529, Survey of Commercial Aviation Gasoline Characteristics, January, 1949 Production," and may be obtained by writing that Bureau's Publications Distribution Section, 4800 Forbes St., Pittsburgh 13, Pennsylvania.

The survey covers laboratory analyses of the 74 samples manufactured by 17 producers, and includes 20 samples of Grade 80 fuel; 20 samples of Grade 91-98; 23 samples of Grade 100-130; and 11 samples of Grade 115-145. The work was carried out in cooperation with the Coordinating Fuel and Equipment Research Committee of the Coordinating Research Council, Inc.

Crude Runs Drop

Crude runs to stills in the Ohio Oil Company's two refineries amounted to 26,000 bbl per day during the last quarter, according to that company's annual report. This is a drop of 6½ per cent from the same period last year. Most of the decline took place at Lovell, Wyoming, where a combination of decreased fuel oil demand and an exceptionally severe winter was instrumental in reducing operation.

Erects Gas Treating Plant

A gas treating plant to extract the hydrogen sulphide from natural gas coming from wells operated by the Pure Oil Company, and a sulphur recovery plant to reduce the hydrogen sulphide to elemental sulphur is being erected at Worland Dome, Washakie County, Wyoming, by the Texas Gulf Sulphur Company. The Girdler Corporation is the general contractor supplying the engineering design and all equipment. The extraction of the hydrogen sulphide from the natural gas will be by means of the Girbotol process developed by The Girdler Corporation and now in use for the purification of industrial and natural gases in over 200 plants throughout the world.

Approve Lubricant

Mobilfluid 200, new fluid for automatic transmissions made by Socony-Vacuum Oil Company, Inc., has been approved by General Motors Corporation for use in Dynaflow and Hydramatic transmission, it is announced. Thus it will not be necessary for motorists to depend solely on car dealers for servicing these units. The new fluid is reported to be very stable chemically, and to have high viscosity index, low pour point, and to resist excessive foaming.

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PERSONALS

Ralph R. Matthews

The lubricating grease and lubricating oil business in these United States simply would not be the same if Ralph Matthews had chosen earlier to study seriously, say, appreciation of classical music. A Native Son and a Golden Bear graduate, Ralph in his scholastic years "fi't the Red Shirts" from Stanford with the best of them; learned the "smell" of fog on San Francisco Bay, discovered that all weather in California is "unusual," and after school lent a capable hand to the building of the oil industry on the Pacific Coast and elsewhere.

Ralph (Railroad) has a goodly number of Firsts to his credit; two of the most outstanding are the establishment of the U. S. Bureau of Mines office and laboratory in San Francisco in 1912 soon after he graduated from the University across the Bay; and the organization of the Petroleum Division of the American Chemical Society. Once the Bureau unit at San Francisco had steam up, he left it to join Shell Oil Company of California as a chemist; since that time he has been active in working out the problems of the oil technologist, especially in the lubricating field, during almost all the growing life of the industry.

When Shell needed a chief chemist at Roxana Petroleum Company across the Mississippi from St. Louis, already a Shell subsidiary, he was sent from his native California there for the job. With a 'hitch' at that, followed by one as assistant superintendent of that refinery (Wood River), he was suddenly hauled on the carpet and commissioned to organize Roxana's lubricating department in the company's marketing division. There he early locked horns with specifications for lubricants, and has never been disentangled from that important field. This department saw the light of day in 1923 when much of the history of lubricating oil and grease specifications and quality determination was yet to be made. Faced with the inevitable task of aiding in pulling order out of the chaos of the oil industry in his field, he made such a mark that five years later an aggressive oil company in Kansas City reached for him to head its sales department as vice president. Battenfeld Grease and Oil Company wanted and got him. In the development of lubricating oils and greases, in the cooperative workings of the industry, association-wise and otherwise he since has been in the van, especially in improving greases and specialty products. He was made executive vice president in 1947.

Matthews' list of technical and business organizations reads like the roster of American technical societies in the oil, gas, and allied industries. These long years he has been member, and actively, of American Chemical Society, American Petroleum Institute, charter member of the National Lubricating Grease Institute, American Society of Lubricating Engineers, American Society for Testing Materials and Society of Automotive Engineers. In addition to his ever-growing load of his company's business, expanding continuously in size and scope, he has been an active member of innumerable committees, working always to perfect the required products qualities, specifications and methods for utilization. Altogether a dozen or so papers have been presented before these bodies, dealing with currently important problems and suggestions for their solution. Locally he has served two or more terms as chairman of the American Chemical Society's St. Louis section of the Automotive Engineers.

And just to keep his hand in, he is now a Committee D-2 ASTM member; also of the technical committee of National Lubricating Grease Institute, the API Lubrication Committee and the hugely important Fuels and Lubricants Committee of the Society of Automotive Engineers. A life more full of work and service to his business, his industry, his colleagues and his community cannot be found.

▸ **F. C. King** has been appointed assistant manager of the Engineering Department of General Petroleum Corporation, C. M. Reading, department manager, has announced. Native of Toledo, Ohio, King graduated from California Institute of Technology in 1935 with the degree of bachelor of Applied Science. Joining General Petroleum as an inspector in 1941, he was promoted to the refinery engineer's post in 1946; since then he has been occupied mainly with maintenance problems.

▸ **C. F. Smith,** superintendent of the light oils division of the Whiting, Indiana, refinery of Standard Oil Company (Indiana), has been promoted to assistant general superintendent of the Whiting refinery. He succeeds Roy J. Diwoky, who has become executive assistant to the president and a director of Pan American Petroleum Corporation, a Standard subsidiary with headquarters at New Orleans.

C. E. Evans, assistant superintendent of the light oils division at the Whiting refinery, succeeds Smith, and **Dr. Ford H. Blunck,** general foreman of the pressure stills department in the light oils division at Whiting, succeeds Evans.

Smith joined Standard of Indiana in 1928 in the engineering department at the Whiting refinery. After serving at the Casper, Wyoming, refinery from 1933 to 1938, he returned to Whiting, where in 1942 he became assistant general foreman of the pressure stills department. He was made general foreman of the catalytic cracking department in 1946, assistant superintendent of the light oils division in 1947, and superintendent of the light oils division in 1948. Smith received engineering degrees from the Universities of Utah and Illinois.

Evans joined Standard in 1937 as a chemical engineer in the research department at Whiting, and in 1942 was transferred to the manufacturing department as assistant general foreman of the pressure stills department at the Whiting refinery. He became general foreman of the pressure stills in 1946 and assistant superintendent of the light oils division in 1948. Evans is an alumnus of University of Iowa.

Blunck joined the company in 1936 as a chemist in the research department at Whiting, where he became a group leader in technical service in 1940. In 1945 he was transferred to the manufacturing department as acting assistant general foreman of the crude stills department at the Whiting refinery. He became general foreman of the crude stills in 1948 and general foreman of the pressure stills later the same year. Blunck received his bachelor's degree from the University of Illinois and doctor's degree from Northwestern University. During World War II he was in the chemical warfare service.

▸ **Leonard T. Wilson** has been promoted to assistant refinery superintendent, Martinez Refinery of Shell Oil Company. Wilson has been department manager, catalytic cracking at Shell's Dominguez Refinery.

J. D. Davis, formerly department manager, gauging at Martinez refinery, will replace Wilson.

▸ **Byron F. Wingrove,** chief process engineer for lubricating oil and wax, technical department, at Magnolia Petroleum Company's Beaumont, Texas, refinery, has been transferred to the Paulsboro, New Jersey, refinery of Socony-Vacuum. He will shortly assume new duties as assistant to the plant's assistant superintendent in charge of lubricating oil manufacture. Wingrove graduated from New Mexico Agricultural and Mechanical College in 1935, and came to Magnolia in January, 1938.

Francis M. Graves, assistant chief process engineer at the Beaumont refinery, has been named chief process engineer for the lubricating oil and wax section, technical department, succeeding Wingrove. Graves has been associated with the refinery's technical department since 1935. A graduate in chemical engineering from Texas A. & M., his former duties will be assumed by **L. D. Lynch,** according to a refinery announcement.

▸ Appointment of five foremen for Carter Oil Company's new Billings, Montana, refinery has been announced by T. R. Corbett, manager of manufacturing. They are **Paul Dana,** instrument foreman; **James P. Egan,** electrical foreman; **Matthew D. Schafnitz,** pipe foreman; **A. B. Ott,** service foreman, and **Frank Mugford,** chief metal inspector. The latter formerly worked for Colonial Beacon Oil Company's refineries in Everett, Massachusetts, and the Dutch East Indies.

▸ **Louis S. Radeke** and **Paul S. Hawthorne,** employes of Tide Water Associated's Avon refinery, have received substantial cash awards for suggestions submitted during 1948 under the company's suggestion plan.

Radeke, a resident of Martinez, California, won the first capital award in the western division, and second place recognition in the company's national suggestion plan. He was awarded a total of $1600 for his prize winning suggestion. Radeke has been continuously employed by the company since 1942 at the Avon refinery.

Hawthorne, winner of the second capital award in the western division, and recipient of third place honors nationally, is a resident of Port Chicago, California. A relative newcomer to the company, he has been employed at the Avon refinery since December, 1945. He received a total of $1050 for his winning suggestions.

Tide Water Associated's Company suggestion plan is open to company employees, and cash awards are made during each year to employees submitting adopted suggestions to improve operations.

▸ **Arthur L. Clark,** a clerk in the Atlas refinery of the Socony-Vacuum Oil Company, Inc., Buffalo, New York, has received a $1300 award under the company's suggestions system for developing a method of using gas instead of oil for fuel in the refinery's asphalt plant. It is the largest award since the revised suggestion system was installed throughout the company two years ago.

Company executives said the suggestion of Clark was unusual for the fact also that he is a clerical employee without production or supervisory responsibilities. Clark started at the refinery in 1934, and served three and one-half years in the United States Army during World War II.

▸ **Dr. Walter Miller,** vice president of manufacturing for Continental Oil Company until his retirement three years ago, passed away June 8 at his home in Ponca City, Oklahoma. His passing took one of the most outstanding leaders in refining development and technology that the country has known.

Born in 1881 a native of Switzerland, Miller came to the United States at an early age, and during his younger years worked in the eastern part of the country as a machinist's helper, a bookkeeper, and a blacksmith. Later he joined Tide Water Oil Company at its plant in Bayonne, New Jersey, as a yield clerk, eventually becoming process superintendent of the Bayonne refinery for Tide Water. Offered the general superintendency of three refineries by Pierce Refining Company, with headquarters at Tulsa, Oklahoma, Miller came to the southwest, where he spent most of his life.

He was promoted to the managership of Cosden and Company, which later became the Mid-Continent Petroleum Corporation, located in Tulsa, Oklahoma. A short time afterward he took up consulting work with Marland Oil Company of Ponca City, and was put in charge of all refining operations at the Ponca City plant. When Marland interests were merged with those of Continental Oil, Miller was retained as vice president of refining, in 1929. He remained in that position until he retired in 1946.

He was a member of many organizations, including the American Petroleum Institute of which he was a director in the division of refining for several years. He was always attentive to the development of younger people in his chosen field, and his work in that regard earned him very wide acquaintance and innumerable friendships among the younger generation of refinery technologists and engineers.

▸ **W. T. Cravens** has been named assistant general superintendent of the refining division of Cities Service Oil Company (Delaware). He will act as assistant to Lee Haugen, who is general superintendent in direct charge of all refinery operations.

Cravens has been with the Cities Service companies for the past 12 years, having worked at Shreveport and Lake Charles, Louisiana, and recently in the New York office for Petroleum Advisers, Inc.

He is a graduate of the University of Arkansas and will make his headquarters in Bartlesville, Oklahoma.

▸ **R. L. Nichols,** instrument shop foreman at Magnolia Petroleum Company's Beaumont, Texas, refinery, has been named area vice chairman of the South Texas section of the American Society of Mechanical Engineers. His area covers the Beaumont, Orange, Port Arthur triangle. Nichols has been associated with Magnolia since 1916.

▸ **Dr. V. I. Komarewsky,** professor of chemical engineering and director of the Catalysis Laboratory at Ilinois Institute of Technology, has been invited to speak before the Danish Chemical Society in Copenhagen in September. He will discuss the "Catalytic Reaction of Hydrocarbons."

Komarewsky is an alumnus of Moscow University and has been a staff member of the Kaiser Wilhelm Institute of Biochemistry in Berlin and the Moscow Academy of Mines. He was a lecturer at Northwestern from 1932 to 1934 and joined the staff of Illinois Tech in 1936.

Hawks-eye view of new Johns-Manville Research Center in New Jersey.

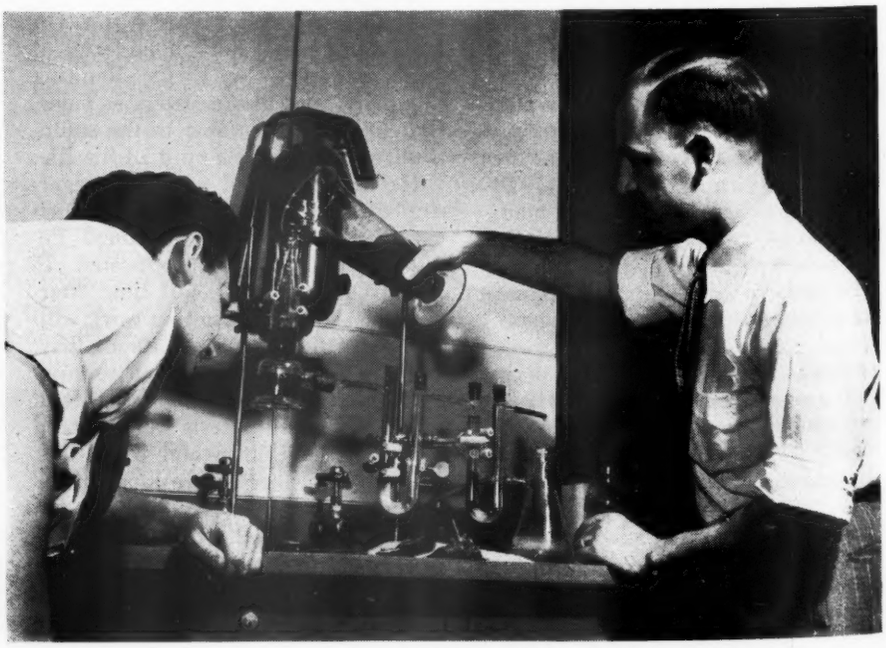
New Research Laboratory Completed

The great new research laboratory completed recently by Johns-Manville Corporation at Manville, New Jersey, is one of the largest, possibly the largest of its kind in the world. Foreign countries represented in this development and dedication included embassy and other officials from Argentina, Mexico, Colombia, Bolivia, Chile, Costa Rica, and Cuba. The laboratory was dedicated by Governor Alfred E. Driscoll in the presence of company officials and 500 visiting scientists, engineers, and foreign industrial and business leaders.

The institution includes four large main buildings, on 93 acres in the Raritan River, 40 miles from New York. Research is directed to the improvement of the more than 400 lines of building, insulation and other industrial materials manufactured by the company's 20 great plants, in the U. S. and in foreign countries. This laboratory is part of a $60,000,000 expansion project by the J-M company. Buildings include the product development building, research and administration building, mechanical building, and the engineering building. Auxiliary units are the filtration plant, waste water treating plant, steam power and sanitary systems, etc.

Among the lines of products on which research and experimental work is carried on continuously by the highly trained employes are high and low temperature insulating materials, of which one project is the making of insulation to meet the extreme demands of modern jet aviation engines, transite and other asbestos board, paper, cloth and similar products, catalysts and catalyst carrier materials employed widely in the chemical, and petroleum refining industries, refractories designed to withstand more than 3000 F temperatures, and many others.

Among the company officials present during the ceremony were Lewis H. Brown, chairman of the board of directors, Dr. C. F. Rassweiler, vice president for research and development in charge of the laboratories, and K. W. Huffine, vice president and director of engineering. ★ ★ ★



Two researchers at work in one of the new Johns-Manville laboratory units.

Canada Needs Pipe Lines

SOMEONE has said that the true history of a nation is the history of its transportation. A similar statement could well be applied to the petroleum industry, because regardless of how much oil and gas are found, they are of no value unless made available to the consumer. This is where pipe lines and other methods of transportation enter the picture. The Alberta fields of western Canada provide an immediate case in point.

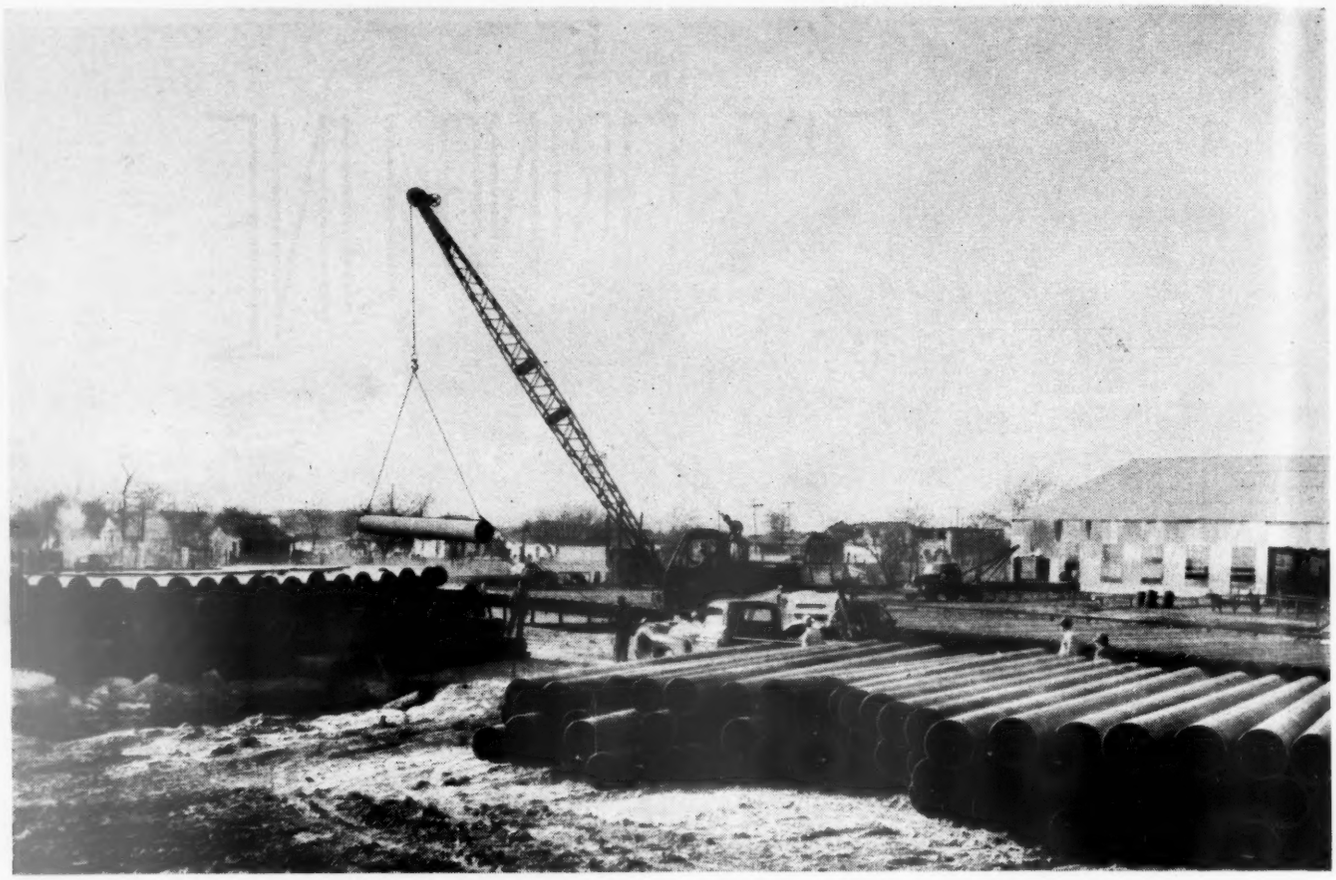
Drilling operations in that booming area are bringing in many new wells, which are adding to potential production but not to current production. Wells are being produced on a restricted basis because new markets cannot be reached that will absorb a larger part of the potential output. These facts have been pointed out by H. H. Hewetson, chairman of the board of Imperial Oil Limited. The same situation exists in the case of the large gas reserves that have been discovered in Alberta incident to the search for oil.

As a result, two extensive pipe line projects have been announced. From Edmonton to Regina a 450-mile crude oil line will be laid, beginning immediately, and this system undoubtedly will be extended on to the Great Lakes area. Such an extension will be necessary in order to really expand the existing market for Alberta crude oil as prairie refineries already are taking all the oil they can and crude is moving beyond Regina by tank car.

The second proposed project is construction of a 1400-mile gas pipe line from northern Alberta to Vancouver, thence south through Washington and Oregon into northern California.

With these two outlets—for oil and gas—development of western Canadian fields should go ahead at an even greater pace than heretofore.

J. H. Love



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Clamshell removes blasted rock from ditch.

P 615.3

Constructing Ozark Pipe Line System

FRANK H. LOVE*

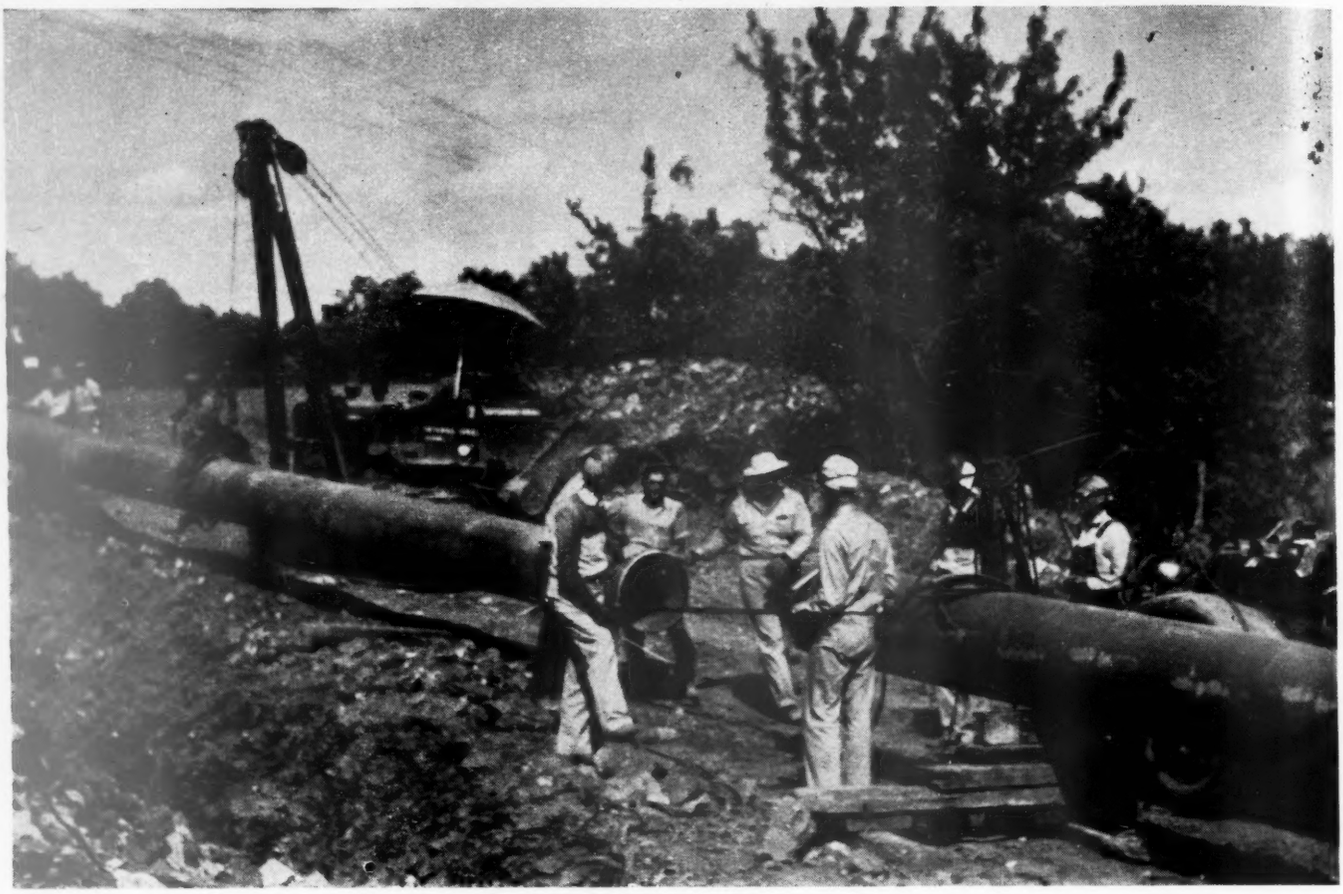
EXCLUSIVE

THE Ozark hill country, world famous for its scenic beauty and majestic grandeur, lives up to every adjective the travel folders claim for it, but to pipe line crews charged with the responsibility of laying a line through its rocky terrain it is something less than majestic and the scenic beauty tends to become obscured by more practical and less glamorous realities. To them its verdant trees become objects that must be cleared to make right-of-way, its rocks must be blasted before a ditch can be made in which to place the pipe, and its crystal streams that provide vacationing fishermen with a universally popular outdoor sport are barriers that must be crossed so the pipe line may continue on its course.

Shell Pipe Line Corporation, after a considerable struggle with the elements and natural obstacles, has completed a 22-in. crude oil line through this area—from Cushing, Oklahoma, to Wood River, Illinois—a distance of 436 miles. The first oil through the line reached its destination at Wood River the middle of July. Known for identification purposes as the Ozark Pipe Line System, this line is owned jointly by Shell and The Texas Pipe Line Com-

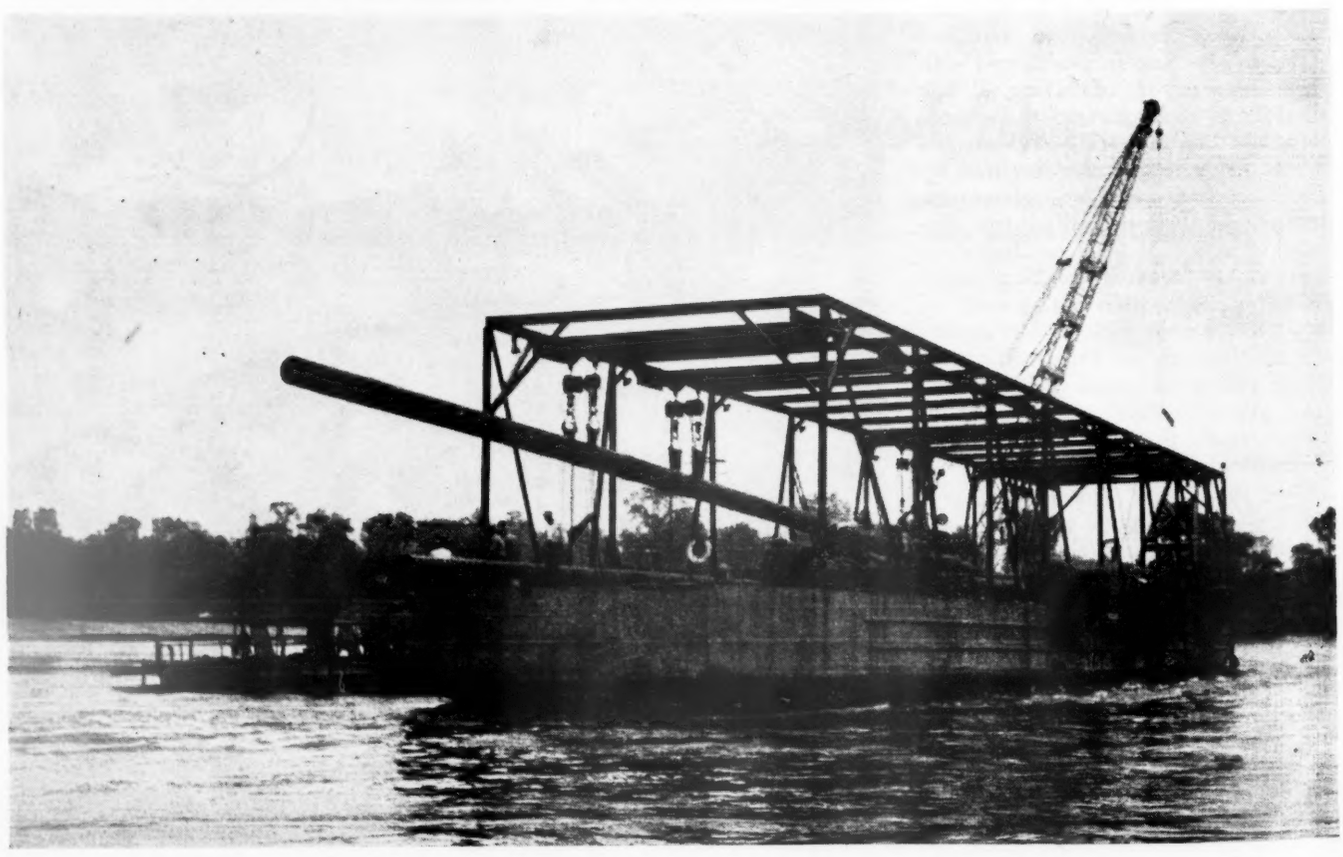
The 50-ft joints were electric arc welded and check tests made by X-Ray.

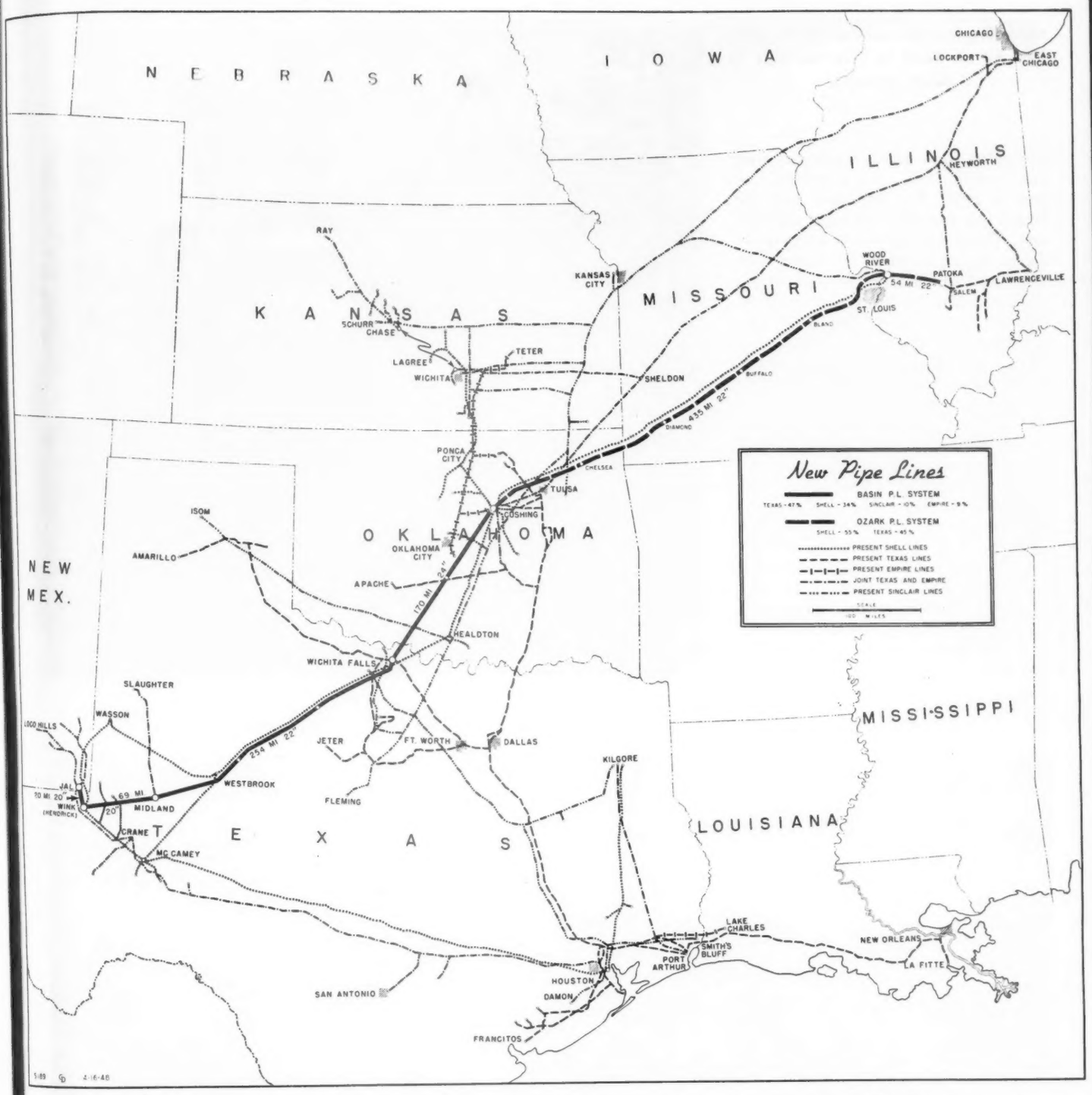
*Pipe Line and Marine Transportation Editor.



Before the stringer bead was run the pipe ends were lined up by an internal line-up clamp.

View of the pipe laying barge used on Mississippi River crossing. It was built from a surplus LSM hull. The barge is about ready to move forward, lowering the pipe into the river, then another section will be added.





pany. It was designed and constructed by Shell, and is being operated by that company.

At Cushing oil is received from the new 20, 22, 24-in. line, known for identification purposes as the Basin Pipe Line System. This line is owned jointly by Texas, Shell, Sinclair Refining Company and Empire Pipeline Company, but was designed and built, and will be operated by The Texas Pipe Line Company. The Basin System has its origin in the Permian Basin of West Texas and New Mexico. Principal deliveries by the Ozark System are to Shell's refinery and to Ohio Oil Company's pipe line at Wood River, and to The Texas Pipe Line Company's 22-in. line extending from Wood River to Patoka for further movement to refineries north and east.

For line construction purposes the Ozark project was divided into six sections. Section 1 extended from Cushing to the Verdigris River and included the Cimarron and Arkansas River crossings. This section was contracted to Midwestern Contractors, Inc., of Tulsa, Oklahoma.

Sections 2 and 3 were from the Verdigris River to a point south of Buffalo, Missouri. River crossings included the Verdigris and the Grand. Smith Contracting Corporation of Fort Worth, Texas, was the contractor for these sections.

Sections 4, 5, and 6, laid by Anderson Brothers Corporation of Houston, Texas, extended on to Wood River, Illinois. Rivers crossed on these sections were the Gasconade, Missouri, and Mississippi, the last two presenting the most difficult construction problems of the entire project. Dual crossings were laid under most of the rivers above named. Contractors made the river crossings included in their sections. Parkhill Truck Company, Tulsa, Oklahoma, did the pipe stringing throughout the line on a subcontract basis.

Five motor-driven centrifugal stations are being installed, situated at Cushing and Chelsea, Oklahoma, Buffalo, Diamond, and Bland, Missouri. Initial operation is with the Cushing, Diamond, and Bland stations. The others will be put on the line as completed. Capacity of the line with all five stations pumping will be 187,000 bbl a day at a maximum operating pressure of 750 psi.

The new 22-in. line parallels Shell's

Normally, the ditch was cut 42 in. wide and 52 in. deep to give the pipe a 30-in. covering.

two older 10-in. lines, a screwed-joint line laid in 1917, and a welded line laid in 1928. For the most part the Ozark line occupies the same right-of-way. There are some few exceptions. As an example, when the older lines were laid a considerable part of the work was done by hand labor, particularly in the case of the 1917 line. Consequently, the policy was to follow the line of least resistance, going around especially bad hills or mountains and laying the line through valleys. Modern equipment made it possible to straighten out some of these deviations and thereby save a worthwhile amount of expensive pipe. Again, in St. Louis County the urban development of three decades made it inadvisable to attempt to lay the new line along the same route. Thus this area was avoided by crossing the Missouri River near Weldon Springs and running through St. Charles County to a Mississippi River crossing at Hartford, Illinois.

Almost all kinds of difficulties were encountered in laying the line—this is just one of them.

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Actual photograph of construction of Shell 22" Mississippi River undercrossing.

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The Mississippi River being navigable it was specified by the government that the pipe have a minimum covering of 7 ft. Here the dredge is making the big channel into which the pipe was lowered.

To convey an idea of the nature of the terrain throughout the route of the line, a brief resumé is here given by sections.

Section 1 was through rolling country except in the Osage hills of Oklahoma between the Arkansas River and Skiatook. For a distance of approximately 25 miles sandstone and limestone were encountered. Virtually all had to be shot to make ditch. Throughout this section, also, were many creeks and canyons, beneath which the line was laid.

Section 2 in general was through rolling country, but after the Missouri state line was crossed the terrain became rocky and rough, the flint and limestone rocks necessitating blasting. This rough area also was about 25 miles in length, extending from Grand River in Oklahoma to the new Diamond pumping station in the Missouri Ozarks.

Section 3 was much the same type as the previous section, becoming rocky on the last 30 miles of the east end.

Section 4, from the new Buffalo station to the Gasconade River was entirely in the Ozarks and through heavy timber and generally rocky terrain. From 60 to 70 per cent of the ditch had to be shot in this area.

Section 5 continued much the same as Section 4, being generally rocky and requiring much shooting. The west 10 miles of Section 6 was possibly the roughest part of the entire 436 miles of line. This was through hilly, rocky, and timbered country. The right-of-way then entered flat delta country. The two most difficult river crossings—the Missouri and Mississippi—were also on this section. Additionally, a 7000-ft swamp just east of Orchard Farm, Missouri, had to be coped with. During flood stages the Mississippi and Missouri rivers occasionally back over or cut through this land. It was impossible for conventional ditching equipment to operate in the area, so the pipe line ditch was dug with backhoes.

The main line of the Ozark System was laid of 11/32-in. wall electric welded pipe, which was manufactured in 50-ft lengths. Such pipe weighed 79 lb per linear ft. River crossings were laid of ½-in. wall, seamless, weighing 114.89 lb per ft, and manufactured in 40-ft lengths. Welding was by means of the electric arc and normally main-line joints were given four beads, a stringer and three finishing beads. River pipe was given anywhere from seven to nine beads as required, after which the joints were reinforced by welding sleeves.

FOR PICTURES OF SHELL PERSONNEL CONNECTED WITH CONSTRUCTION OF LINE SEE "TRANSPORTATION PICTORIAL" SECTION, PAGES D-50-51.

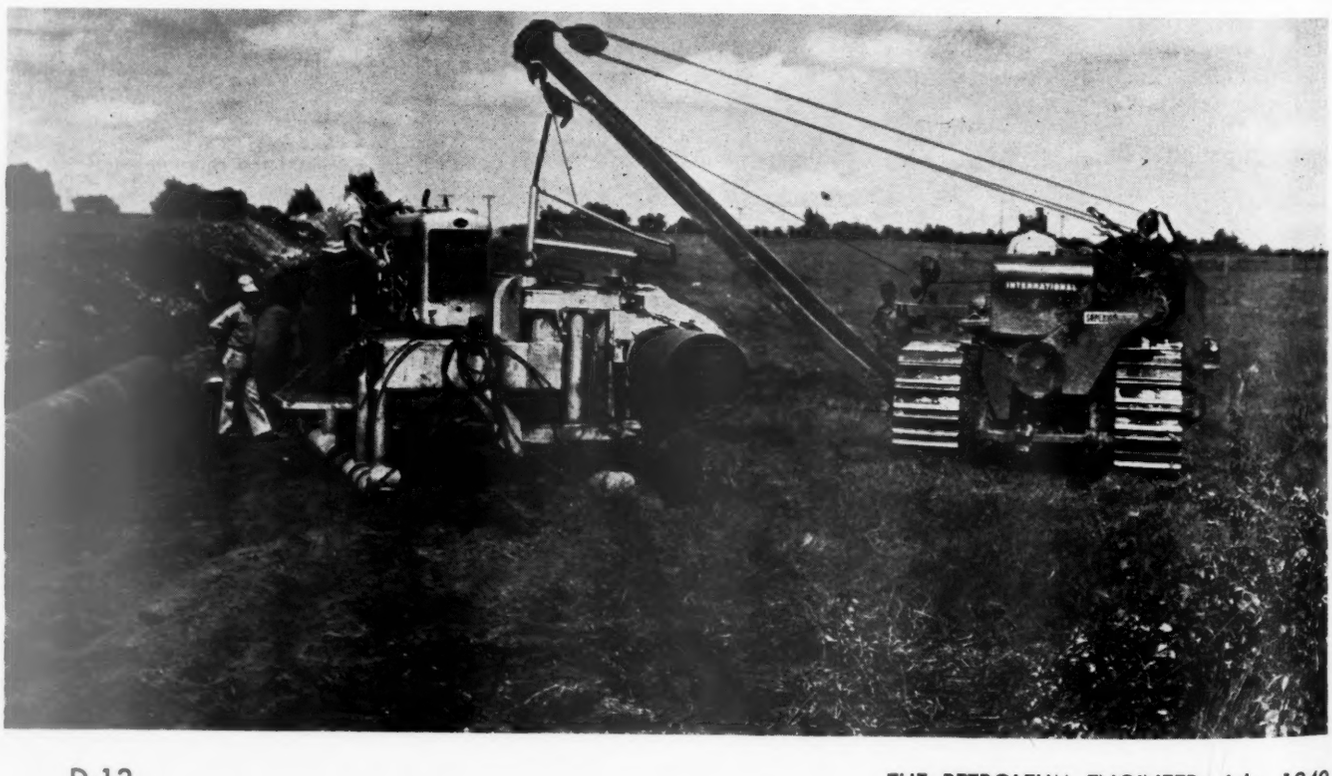
Check-testing of welds was by the X-ray method, which is considered a reliable means of determining faulty work. Although not used for the first time on the Ozark line, development of the method is recent enough to warrant a brief description. Not every weld is tested, but the welders never know when the X-ray crew will move in for the purpose of making spot check-tests, consequently it is incumbent upon them to make every weld as effective as possible.

The X-ray equipment is transported in a trailer pulled by a Jeep. The trailer contains a complete photographic dark-room outfit and the field X-ray equipment. The initial step of the 3-man crew is to wrap light-tight belts containing film around the outside of the welded joints. From 5 to 10 joints are thus wrapped before the first shots are made. An X-ray tube mounted on a self-propelled 4-wheel cart is then placed in the open end of the line. To one end of the cart are attached electric power wires and a steel cable, the latter used to reel the unit in and out of the pipe. As the unit passes a weld, a red light flashes on a control panel. The unit is then stopped by means of two switches and the X-ray circuit energized to take the picture. The tube's rays penetrate the weld and make a picture on the film in the belt that encircles the welded joint, after which the unit is moved to the next joint.

After four such exposures the belts are removed and the film developed in the mobile darkroom. Within 20 minutes the welding inspector has the developed film and is able to determine the effectiveness of the welds. Meanwhile other pictures are being made. The film shows in a continuous picture the entire weld around the pipe and any defects are revealed on the negative. When a section of line has no open ends, pictures of the welds can still be made. This is done by making exposures on the outside of the welds.

[The writer makes acknowledgment to *The Go-Devil*, publication of Shell

The pipe was given a single coat of hot coal-tar enamel to a thickness of 3/32 in. and a double wrap, one an imbedded reinforcement glass fiber material, the other asbestos felt.



It is important to have pipe fit the contour of the terrain. This special equipment makes the bends cold.

Pipe Line Corporation, from which material for this description of X-raying was taken, although not always quoting verbatim.]

Mainline pipe was cleaned externally and given a coat of coal-tar primer followed by a single coating of hot coal-tar enamel to a thickness of 3/32 in. and a double wrap, one an imbedded reinforcement glass fiber material, the other a covering of asbestos felt. Pipe used on river, highway, and road crossings was given three coats of enamel and three wraps. A "holiday" detector was run behind the coating machine and immediately behind the detector, the pipe was sprayed with water to cool the coating. Also, highway and road crossings were cased.

Normally, the ditch was cut 42 in. wide and 52 in. deep, giving the pipe a 30-in. covering. Wherever possible the ditch was made with the customary type of ditching machine, but, as mentioned, a considerable part was through rock that had to be shot, and in such cases the rock was removed by backhoes and clamshells. Through these rocky areas it was specified that the ditch should be padded with dirt both beneath and above the pipe before backfilling to prevent damage to coating.

The Missouri River, because of the swiftness of the current, was the most difficult crossing that had to be made, and the manner in which it was accomplished has been described in a previous article.*

The Mississippi River, crossed with dual lines near Hartford, Illinois, also was an extensive project. It was decided to employ a different method here from that used on the Missouri River crossings, and to lay the pipe from a barge. The barge, built by the contractor, Anderson Brothers Corporation, from a surplus LSM hull, has a number of features that differ somewhat from similar equipment used for the same purpose. The hull, 203 ft long by 35 ft wide, is equipped its full length with an 80-ton overhead traveling crane having a 26-ft pickup clearance. Also, at one end it has a 90-ft boom. The deck area of the barge was great enough to carry at one time all the pipe required to lay an entire river crossing as well as its approaches. Sets of four 40-ft joints were welded together on shore, and the 160-ft sections thus formed were given a triple coating and wrap. When enough of these sections were assembled to lay the entire crossing, which was 2800 ft bank-to-bank, they were loaded onto the barge by use of the 90-ft boom and two load lines, each with a line-pull capacity of 150,000 lb. The barge was brought in as close to the shore as possible and a load line fastened to one end of a 160-ft section of pipe. A boom tractor picked up the opposite end, and the pipe section was then moved down to the water's edge where the overhead crane system picked up the pipe, carried it back the length of the barge, and stacked it along the sides on padded racks. The overhead crane system also was used to line up the pipe sections for welding and to support them at the proper angle while the barge moved ahead to lower the pipe into the river. This procedure was repeated and as each section was added water was pumped into the line from the barge end, providing sufficient weight to sink and hold it in place in the dredged-out trench. A derrick barge held off on the pipe after it came off the boom on the stern of the main barge to keep the pipe from bending before it reached the bottom of the river.

The barge was equipped with six winch lines, two working on the boom referred to above, two being straight anchor winches having 125,000-lb capacity and spooling 1500 ft of 1-in.

*"Crossing the Missouri With Dual Lines," *The Petroleum Engineer*, May, 1949, page D-11.

One of the contractors, Smith Contracting Corporation, had its electric welding equipment mounted on mobile units, shown here on half-tracks. Some of the single welding machines were mounted on a 4-wheel carriage and were self-propelled.

line, the other two spooling 2500 ft of line and having a line-pull capacity of 400,000 lb. The winches were used as combination anchor and barge shifting winches. Five 5000-lb LST ship anchors were a part of the equipment. These held the barge in place during operations and against two of them the pull was made to move the barge forward. In addition, seven 750-lb anchors were used for buoy marking to line up the camber of the course.

Two sea mules formed a part of the auxiliary river equipment. They were 300-hp units with 9-to-1 reduction twin screws and were used to hold the laying barge in line, to transport it, and to tow the auxiliary barge. There was also a 165-hp river type tug used for hauling supplies and workmen, and moving barges from one location to another. Additionally, a 179-ft by 34-ft work barge was available to move equipment, supplies, coating materials, etc., from one job to another and to use in connection with keeping the main barge supplied with materials. The main barge, too, has its own lighting plant for night work and the same generator provides power to operate electrical winches that in turn operate the pipe-laying boom.

On both the Mississippi and Missouri River crossings the pipe was laid beneath the river bed to a greater depth than specified by the government. In the channel minimum covering was 7 ft; cuts on the bank were deeper.

To dig the big channel in which the line was lowered to grade the dredger shown in an accompanying illustration was used. This in itself was an extensive operation, requiring the removal of thousands of tons of sand and silt from the river bottom. After the pipe was lowered it was gradually covered by the washing action of the current. The dredging for the Mississippi River crossing was done by the Minneapolis Dredging Company.

As to the other river crossings, the Arkansas, Cimarron, and Grand could be dredged, but the beds of the Gasconade and Verdigris were of solid rock and were shot to make ditch. On the longer of these crossings the procedure was to weld a section of pipe on shore, tow it afloat into the stream, and connect it to the previous section while afloat. Air in the pipe kept it afloat until water was pumped into the open end to lower it into its channel. On the shorter crossings it was possible to weld enough pipe on shore for the entire crossing and pull it into place with winch lines. No river clamps were used but, as before stated, welded sleeves were employed to reinforce the joints. Bank-to-bank widths of these river crossings were as follows: Arkansas, 2500 ft; Cimarron, 1000 ft; Verdigris, 400 ft; Gasconade, 300 ft. and Grand, 5000 ft. Actually, the crossing of the last was at Grand Lake, formed by a junction of Spring and Neosho rivers, which is the source of the Grand River.

After each section of the line was welded, coated, laid in the trench, and backfilled, it was filled with water and given a hydrostatic pressure test of 1000 psi. Portable oil-well cementing pump equipment was used for this purpose. About 50 miles of line was tested at each "squeeze."

The Ozark project was well planned from the beginning, and with anything like favorable working conditions the job would have been completed ahead of schedule. One of the worst winters in many years with excessive rains, snows, and ice during January, February, and March, however, turned the right-of-way into a quagmire and slowed down operations, although work was never completely stopped. As a consequence the job was finished two weeks behind schedule, which is remarkable considering the obstacles that had to be overcome. ***

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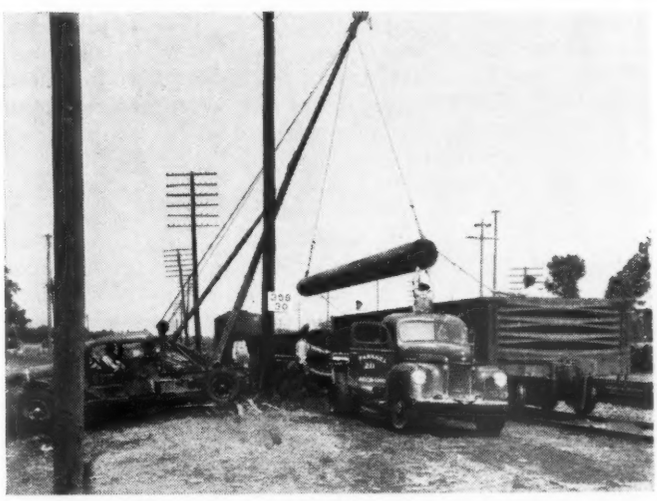
Texas Empire Pipe Line Co.	70	18″
Texas Gas Transmission Co.	180	26″
Virginia Gas Transmission Co.	65	26″
Northern Natural Gas Co.	60	24″
Buckeye Pipe Line Co.	68	22″
Mississippi River Fuel Co.	215	22″
Stanolind Oil & Gas Co.	150	various
Transcontinental Pipe Line Corp.	200	30″
TOTAL	1584	



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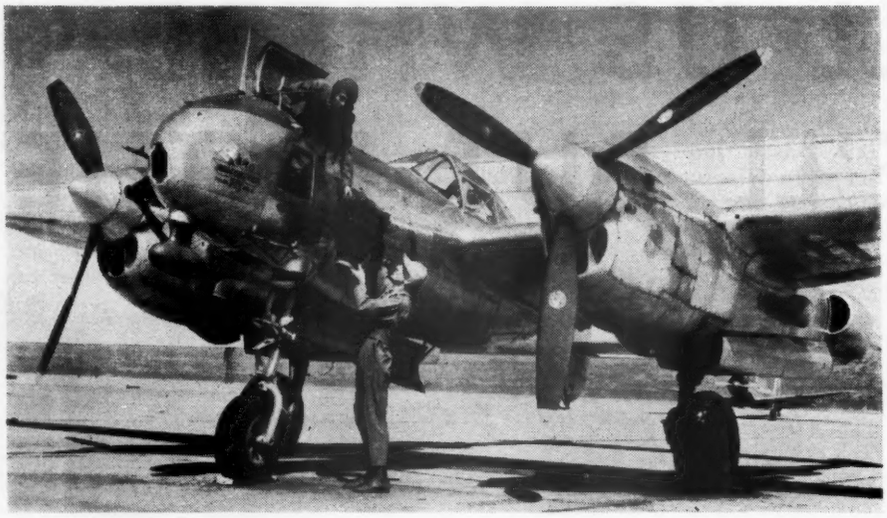


Crewmen, A. L. Welty and Jamie K. Sanford, making preparation for takeoff in Lockheed P-38 aerial photographic plane used in the surveying of right-of-way for pipe lines.

Aerial Surveying Transcontinental Line

FRED Q. CASLER*

FISH CONSTRUCTORS, INC., Houston, Texas, are completing the work of locating the 1800-mile main gas transmission line on aerial photographic maps for Transcontinental Gas Pipe Line Corporation. The survey for it was recently completed by the Aero Exploration Company of Tulsa, Oklahoma. With the location problems almost completely solved, right-of-way acquisition and actual construction is getting under way for the huge project. The line originating in the south Rio Grande Valley and terminating at New York City will gather gas in the southwestern fields for delivery to the industrial East.

To speed up locating the pipe line route, the engineers have made unusual arrangements that enabled them to carry on their work expeditiously. The aerial survey was begun on November 29, 1948. All actual photography was completed within a four-week period for the entire 1800 miles of main line. The finished delivery after laboratory processing included one master mosaic assembled in convenient length strips, an exact copy of this master mosaic in atlas sheet form, and several sheets of stereoscopic prints for study of topographic details affecting right-of-way location.

Two Lockheed P-38 airplanes of the Aero Exploration Company were used in completing the aerial mapping. Each of these planes is manned by a crew of two consisting of a pilot and photographer. The aircraft are modified from the original military version for two-man photographic operation. The cameraman with a complete set of instruments pertaining to photography rides in the nose of this high performance aircraft. Flying was done at about 15,300 ft above the surface of the ground—the actual sea level altitude varying with the ground datum existing over the route.

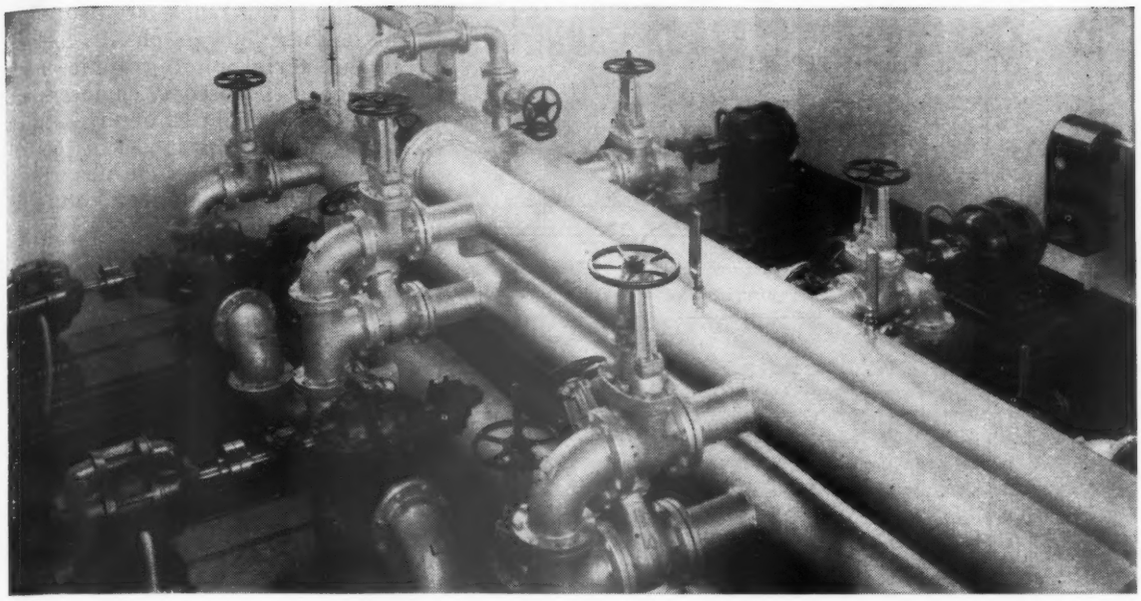
The original photographs are at a scale of 1:20,000 or about 3 in. to the mile. The photographic planes cruise at about 275 mph. Exposures were made at about every 8 to 10 seconds to obtain a 60 per cent photographic overlap from one photograph to the other. At these high speeds, an error of but a fractional part of a second in timing can mean missing of this overlap and with consequent resulting deficiency in stereoscopic photography. Each exposure is made with the shutter speed of 1/150 of a second.

The film used has a special emulsion adapted for photographing through high haze conditions that were encountered at various points of the line. Each roll of film yields 200 exposures and each exposure shows over all approximately 9 square miles. In the eastern states poor visibility conditions were encountered and for a good part of the time the pilot was unable to see ahead for more than 3 or 4 miles. In this area, the photographic airplane could only operate a few hours each day during that period of greatest sunlight intensity.

In the finished photographic maps, all important topographic details are clearly represented. Examination of the aerial photographic maps prepared for this project reveals the great improvements that have been made in modern photogrammetric methods in recent years. Many of those in the industry who are familiar with the fact that aerial maps are used in pipelining still do not realize that the aerial photographs serve as the route maps themselves. Towns, rivers, sections,

*President, Aero Exploration Company, Tulsa, Oklahoma.

EXCLUSIVE



PUMP HOUSE *in booster station, showing Crane gate valves and flanged fittings.*

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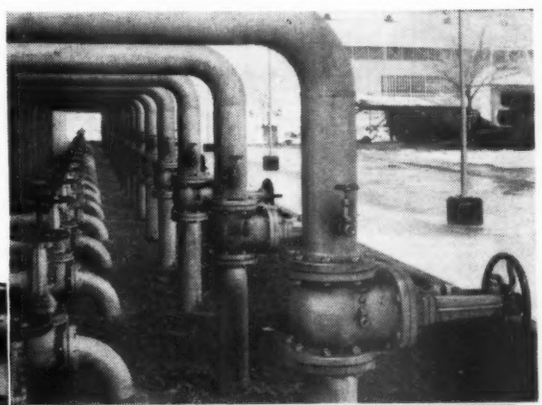
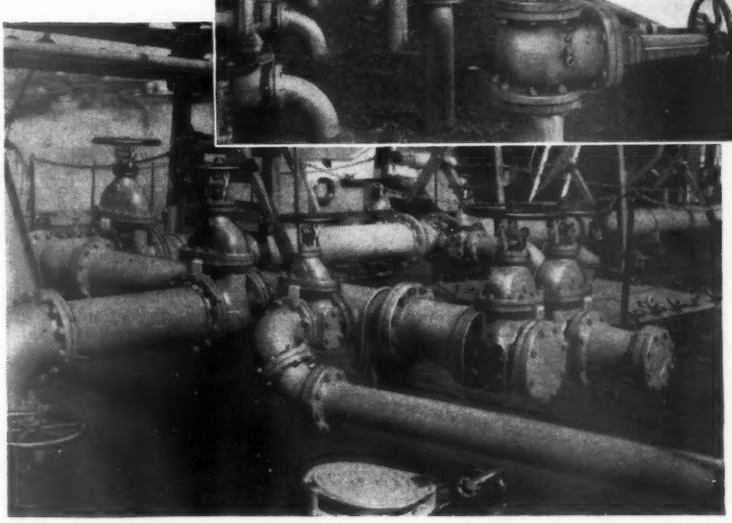




OIL TANKER *equipped with Crane iron body wedge gate valves, globe valves, pipe, flanged and screwed fittings.*

EVERYTHING FROM . . .

VALVES
FITTINGS
PIPE

CRANE

PLUMBING
AND
HEATING

FOR EVERY PIPING SYSTEM

TYPICAL FLIGHT REPORT

AERO EXPLORATION CO.
Tulsa, Oklahoma
Photographic Flight Record

Date DECEMBER 13, 1948

Contract No. _____ For _____ Item _____

Location PIPE LINE Av. Elev. _____
Base Airport ROANOKE Elev. _____
Working Altitude 16,500 +

Indicated Altitude	Temp.	Corrected Altitude Reading	

Weather CLEAR Wind NW Sunrise _____ A.M.
Camera MARK HURD Lens 8.25" No. 757832 Filter YELLOW Film SUPER XX

	Roll	Flight	START Direction	START Time	START Exp. No.	END Exp. No.	END Time	Weston Meter	Altimeter	Temp. Aloft	REMARKS
XFS	9	7-8	NE	11:10	1	9	11:12		17,200	-6°C	
			SW	11:13	10	18	11:16				
			NE	11:19	19	29	11:24				
			NE	11:26	30	61	11:37				
			NE	11:41	62	68	11:45				
			NE	11:50	69	91	12:01				
			NE	12:16	92	100	12:43				
			NE	12:50	151	160	12:55				
			NE	1:01	161	176	1:05				
XFS	10		NE	1:18	1	12	1:22				
			NE	1:23	13	18	1:26				
			NE	1:28	19	24	1:32				

TIME
TODAY 6:00
TOTAL

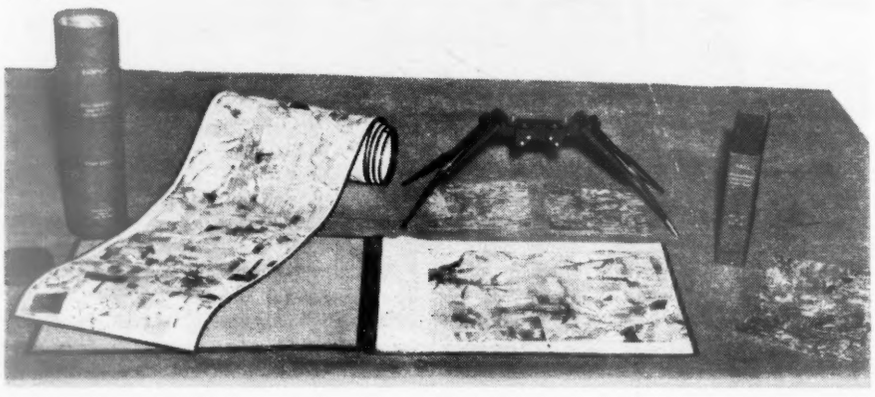
Plane No. NC 73716
Pilot A. L. WELTY
C. R. KECK
Signature of Photographer
Cross Country Flying and All Other Flying
From ROANOKE - NEW YORK
To BALTIMORE - ROANOKE

Take off 09:50 3:10 M.
Start Photo 11:10 M.
Stop Photo 1:32 M.
Land 2:40 4:20 M.
BALTIMORE FOR GAS
Take off M.
Land M.

CLIMB Hrs.	CLIMB Min.	PHOTO Hrs.	PHOTO Min.	DESCENT Hrs.	DESCENT Min.	TOTAL Hrs.	TOTAL Min.

Gas Used
Oil Used

Typical example of aerial photographic survey delivery for pipe line location work consisting of rolled master mosaic, a book of atlas sheets, and contact prints with stereoscope for third dimensional study of topographic conditions.



townships, and ranges are marked in ink on these photographs. By looking at the aerial photographic maps through a stereoscope, engineers are seeing what might be observed in an accurate miniature model of the terrain, which will show all hills, rivers, buildings, trees, and other features in three dimensions.

Work at the headquarters laboratory of the Aero Exploration Company is organized to give pipeline engineers maps suited to their needs with the greatest of expediency. Rolls of exposed film are received daily from the aerial cameraman flying the route. From the negatives, contact prints are made 9 by 9 in. square, which are assembled in strips in such a way that they are conveniently available for stereoscopic study. Enlargements are then made to a scale of 1000 ft to the inch or 5.28 in. to the mile. These enlargements are then assembled on linen backing in long strips, which may be as long as 50 ft. This is a master mosaic. This map can show in one piece as much as 100 to 125 miles of terrain in complete photographic detail. At the end of one of these mosaic strips, there can be seen the gathering systems and facilities for accumulating the products for transportation.

In the first stages of locating, the route is indicated by a white string stretched across the map. This is held at various control points by pins. This tentative route is then scrutinized and criticized by all of the engineers. After the route has been definitely determined, it is marked on the aerial photographic mosaic map with an ink line.

Location of the line has been proceeding at an average rate of 100 miles per day. The cost of the large-diameter pipe to be used in this project will be larger in proportion to the construction cost than is customary. Therefore, an effort is being made to show a route as straight as practical. The principal features to be considered are towns, river crossings, and severe topographic conditions affecting construction costs. Wherever possible, high ground above drainage areas is selected. Orchards, farm houses, and areas where slides may occur must be considered.

The entire route has been and will be checked on the ground after selection on the aerial photographs. So far, it has been found that few changes are required and these called for deviations of less than 200 ft. It has been found that the location as made on the aerial photographs can be accepted and let stand for 98 per cent of the mileage. ★ ★ ★

for low cost and high speed ditching

on the "Ozark" and "Transcontinental Gas" pipe lines

Buckeye Model 51 Pipeline Ditchers are used

"Continental Gas" and "Ozark" are typical of the many large pipe line jobs which have used, are using, and will use the Buckeye Model 51 Ditcher. There is a good reason for this almost universal preference . . . contractors have found that they can cut their ditching costs, save time and avoid delays by using Buckeye Ditchers.

Among the many important advantages of the Model 51 are: 32 digging speeds up to 35 ft/min; 110 hp (@ 850 rpm) heavy-duty Diesel engine provides abundant power with minimum fuel consumption; cuts a smooth ditch up to 50" wide and 8'-6" deep; design is simple and servicing is easy. The "51" can maintain a level ditch while digging up or down a grade, and the new replaceable rooter bits cut a clean face and last longer. Ground bearing pressure is low and safety device holds ditcher on grades. If you have a large pipe line job, you can't afford to be without the Buckeye Model 51 Pipeline Ditcher. Write for Bulletin 51.

GAR WOOD INDUSTRIES, INC.
FINDLAY DIVISION—FINDLAY, OHIO

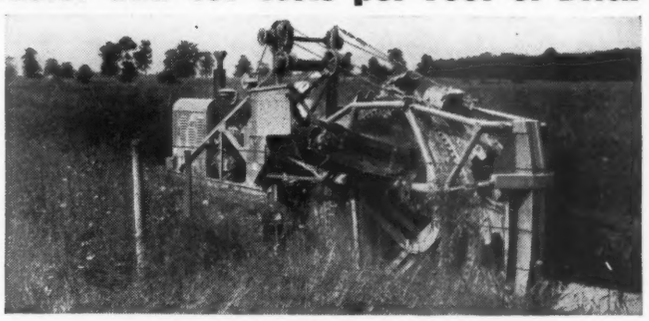
Other Products: Buckeye Shovels, Spreaders and Finegraders; Gar Wood Scrapers, Dozers, Hoists, Dump Bodies, Winches, Cranes and Tanks; St. Paul Hoists, Dump Bodies and Truck Patrols.

Buckeye GAR WOOD GW INDUSTRIES

Smaller Buckeye Ditchers That Also Dig Faster and Cut Costs per Foot of Ditch

Buckeye Model 312 Pipeline and Heavy Duty Utility Ditcher

Widely used for cross-country and gathering lines to 12", refinery installations, etc. Cuts ditch from 15" to 30" wide and to 6' deep. Ask for Bulletin 312.



Buckeye Model 306 Utility Ditcher

Popular for gathering lines, gas distribution systems, water lines, electric conduit, etc. Cuts ditch from 12" to 24" wide and to 5'-6" deep. Write for Bulletin 306.

Welding near Linden, Alabama, on section laid by Midwestern Constructors, Inc.

Longest Gas Line Kicks Off

FRANK H. LOVE*

CONSTRUCTION of the longest natural gas pipe line ever laid in this country —that of Transcontinental Gas Pipe Line Corporation—is under way. After observing appropriate ceremonies at Laurel, Mississippi, in which Claude A. Williams, president of Transcontinental, participated, as well as other top officials of that company, executives of Fish Constructors, Inc., builders of the line, Mississippi's governor, contractors, and many other prominent individuals and organizations, the work was started in earnest. Totaling 1839 miles of main line and some 400 miles of laterals for gathering and delivering gas, it will require approximately two years to complete. Projected for 1949 are 612 miles of the 30-in. main line, contracts having been awarded to four contractors for this work. Three are now laying pipe and the fourth is expected to begin construction in September.

The line, which will cost approximately $190,000,000, is designed for an initial capacity of 340,000,000 cu ft a day at an operating pressure of 800 psi, which can be increased to 505,000,000 cu ft a day by the addition of compressor stations.

Overall, the main line will consist of 1210 miles of 30-in. pipe, 558 miles of 26-in., and 71 miles of 20-in. Originating near Mercedes, Texas, in the Lower Rio Grande Valley (see strip map), the route of the line passes near Alice and Victoria, Texas, then proceeds northwest of Houston, north of Beaumont, Texas, and Lake Charles, Louisiana, and crosses the Mississippi River about 50 miles north of Baton Rouge. From there it goes in a northeast direction and passes near Montgomery, Alabama, Atlanta and Athens, Georgia, turns more sharply north to pass near Spartanburg, South Carolina, Winston-Salem, North Carolina, and Lynchburg, Virginia, then goes west of Washington, D. C., north of Baltimore, Maryland, and Philadelphia, Pennsylvania, and into Linden, New Jersey. From there the route is north through Elizabeth and Newark, New Jersey, to the terminus on the east bank of the Hudson River, at 132nd Street, New York City.

For pictures of individuals connected with line see "Transportation Pictorial" section.

During 1949 the main line between Eunice, Louisiana, and Athens, Georgia, will be laid. Fish Constructors, Inc., of Houston, Texas, acting as agents for Transcontinental, has let contracts as follows:

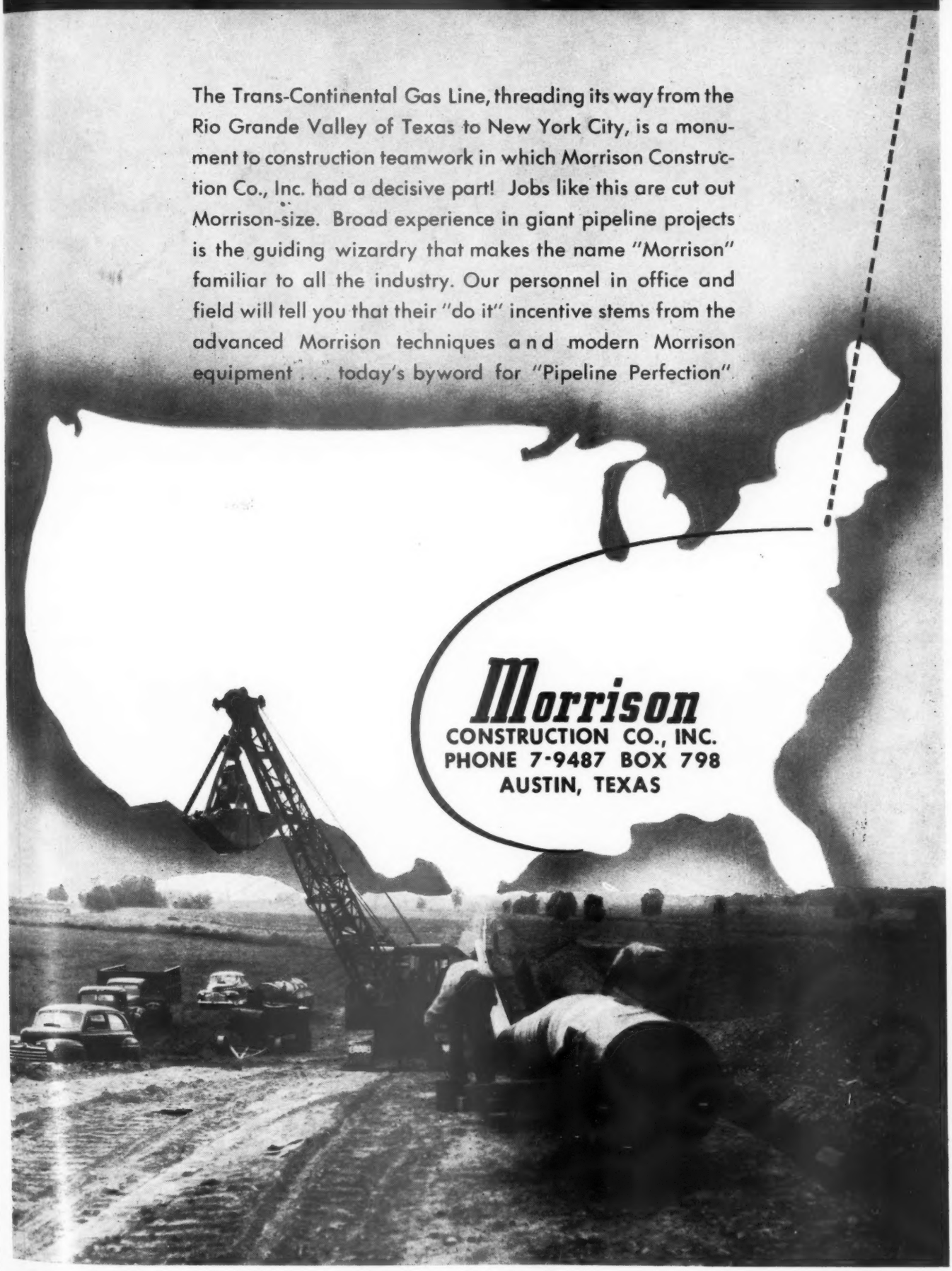
Schedule No. 1, which extends from Eunice to the Mississippi River, a distance of approximately 67 miles, will be constructed by Morrison Construction Company, Austin, Texas. Schedule No. 2, from the Mississippi River

*Editor, Transportation.

EXCLUSIVE

TEXAS NATURAL GAS GETS A THROUGH TRIP TO NEW YORK!

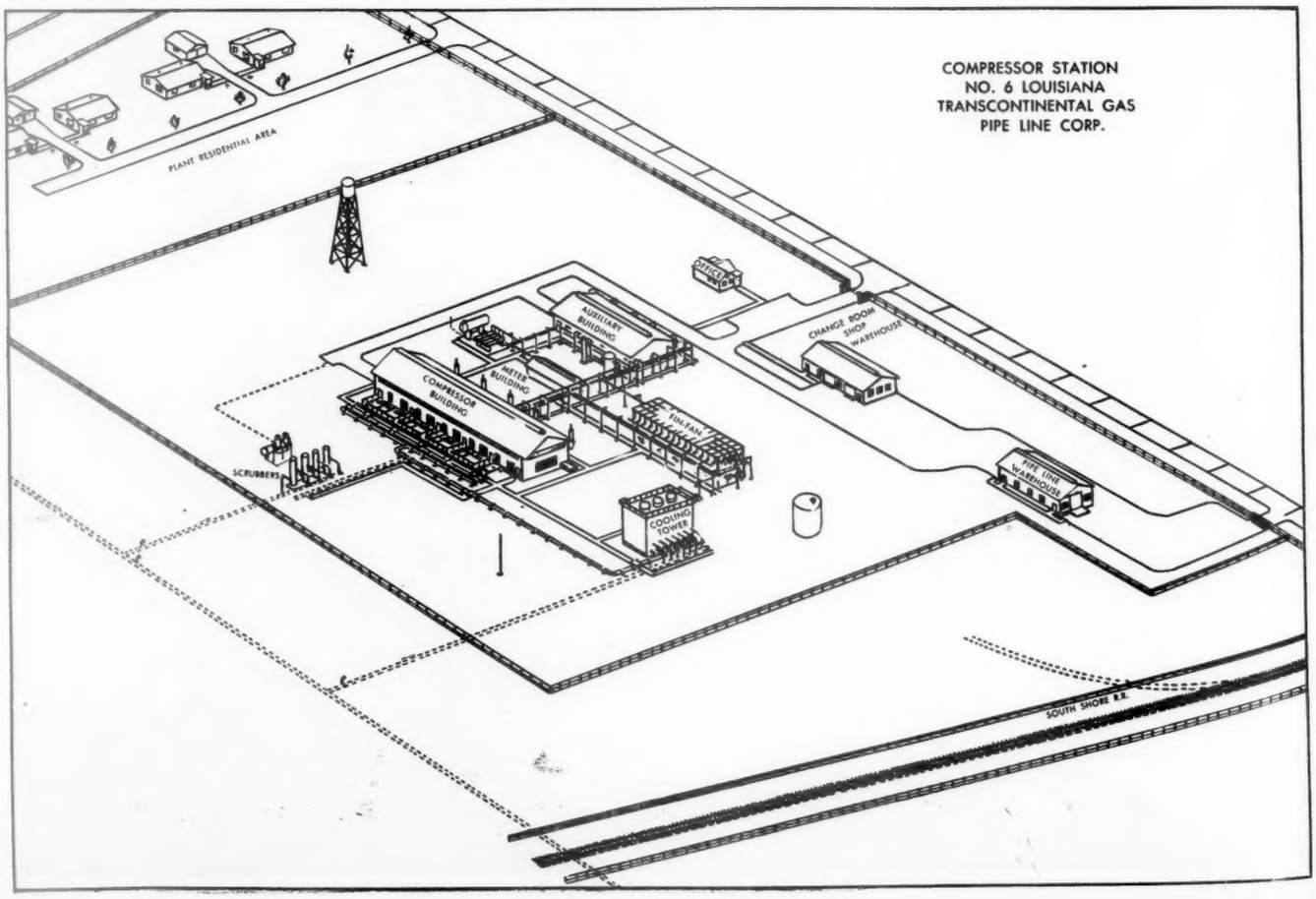
The Trans-Continental Gas Line, threading its way from the Rio Grande Valley of Texas to New York City, is a monument to construction teamwork in which Morrison Construction Co., Inc. had a decisive part! Jobs like this are cut out Morrison-size. Broad experience in giant pipeline projects is the guiding wizardry that makes the name "Morrison" familiar to all the industry. Our personnel in office and field will tell you that their "do it" incentive stems from the advanced Morrison techniques and modern Morrison equipment . . . today's byword for "Pipeline Perfection"



Morrison
CONSTRUCTION CO., INC.
PHONE 7-9487 BOX 798
AUSTIN, TEXAS

Dunn Brothers, stringing contractors, loading pipe at Columbia, Mississippi, for stringing on Morrison Construction Company spread.

Drawing showing layout of compressor stations, five of which will be built this year.

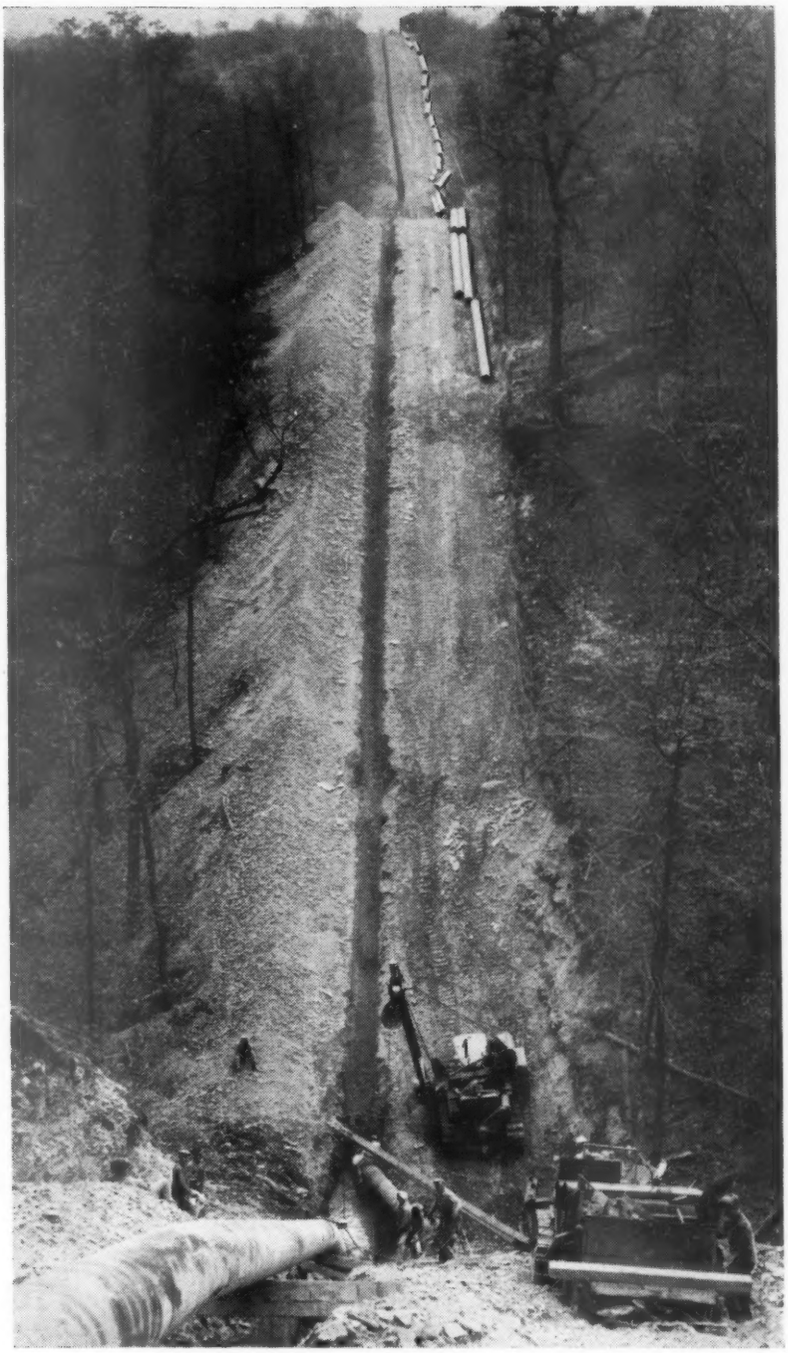


It's More than "Layin' Pipe!"

Pipe Line Construction is a Combination of...

- **ENGINEERING SKILL**
- **ADEQUATE PERSONNEL**
- **EXPERIENCED CREWS**
- **MODERN EQUIPMENT**
- **CUSTOMER SATISFACTION**

PIPE LINE ENGINEERS CONTRACTORS
Williams Brothers Corp.



The successful construction of 35,000 miles of pipe lines on three continents in the past 34 years is proof of the unbeatable combination of skilled personnel and modern equipment that Williams Brothers maintain.

Williams Brothers will master the hazards of swamps, rivers, deserts and mountains to successfully complete your pipe line.

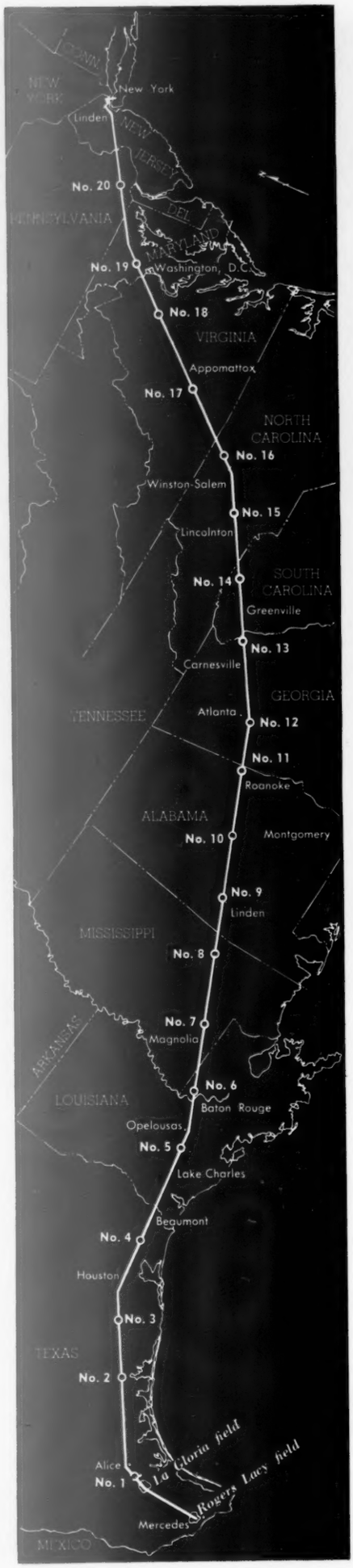
You'll find our trained engineers and specialists eager to assist you with your construction plans and you'll find Williams Brothers can serve you better.

WILLIAMS BROTHERS CORP.

ENGINEERS—CONTRACTORS

Oil • Gas • Gasoline • Water
Pipe Lines and Pump Stations

NEW YORK • TULSA • ATLANTA • HOUSTON



Strip map showing route of Transcontinental line and location of 20 compressor stations.

to a point near Highway 42 in Mississippi, a distance of approximately 112 miles, also will be built by this contractor. Pipe already is being laid on this schedule.

Schedule No. 3, beginning at Highway 42 in Mississippi and extending to the Tombigbee River in Alabama, a distance of about 110 miles, is being constructed by Wunderlich & Griffis Construction Company, Tulsa, Oklahoma. A considerable part of the right-of-way has been cleared and pipe is being laid.

Pipe is also being laid on Schedule No. 4, from the Tombigbee River to the Coosa River in Alabama, a distance of approximately 112 miles. The contractor on this schedule is Midwestern Constructors, Inc., Tulsa, Oklahoma. Schedule No. 5 likewise will be handled by this contractor. This section extends from the Coosa River in Alabama into Georgia, a distance of 110 miles. Work will not begin on this schedule until about the first of September, although some

We Showed Them How We Do It

At Laurel, Miss., before the huge gathering which attended ceremonies for initial construction on Transcontinental Gas Pipe Line Co's 2,239-mile line, we took pride in demonstrating the speed and efficiency with which we operate. We cleared right-of-way, dug ditch, primed and coated, and completely laid and covered ditch on 550 feet of line.

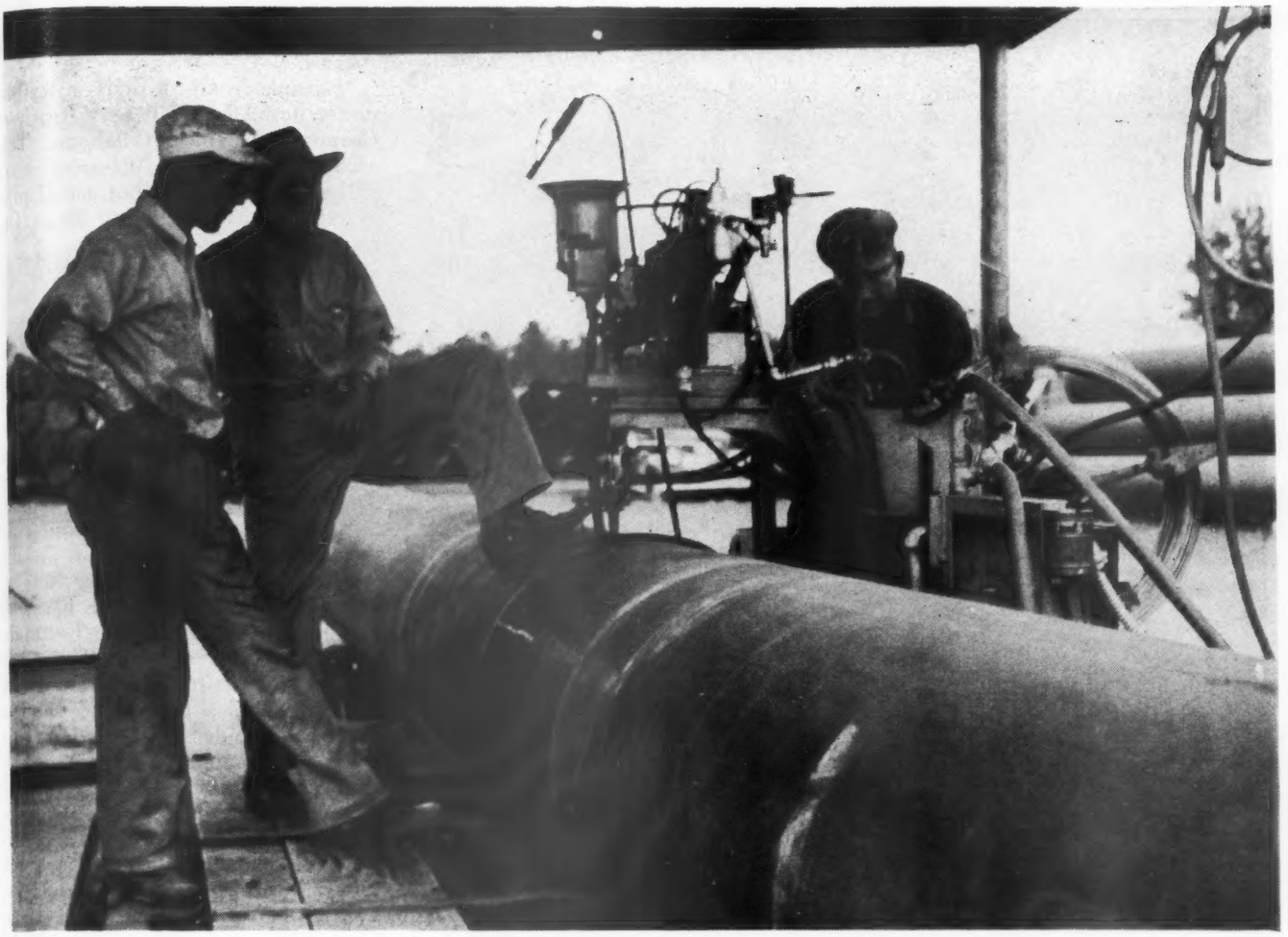
On the Northern Natural Gas Co. line in Iowa we are currently laying some 5,000 feet of pipe a day.

WUNDERLICH & GRIFFIS
PIPE CONSTRUCTION CO.

745 RIVERSIDE DRIVE TULSA, OKLAHOMA

Phones 4-1487; 48370

Affiliated with Wunderlich Construction Company, Omaha, Nebraska



Shamrock Construction Company

Double-Jointing 30-inch O.D. 30-foot pipe for Fish Constructors at Bartow, Mississippi, using Reed Engineering Pipe Rolling Rig, with Linde Air Products Company Automatic Welding Head, Unionmelt Process, M. J. Crose Mfg. Company Pipe Rolling Racks, and Electric Internal Line-Up Clamps.

SHAMROCK CONSTRUCTION COMPANY

F. K. BROWN, *Owner*

BOX 216
CHETOPA, KANSAS
Phone 213

Field Office
McCOMB, MISS.
Phone 1013

Lowering pipe into ditch after it has been coated and wrapped.

right-of-way work will be done in August.

Schedule No. 6, in Georgia, will be constructed by Williams Brothers Corporation, Tulsa, Oklahoma. This section is 112 miles. Clearing work will begin in August, but actual pipe laying will not start until about December 1.

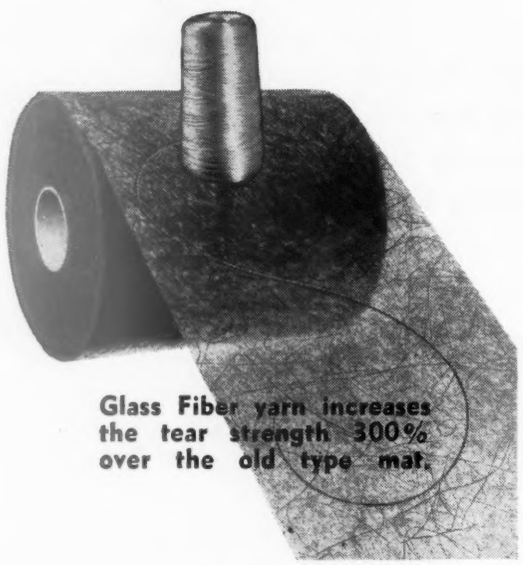
The work on this 612 miles is being supervised by Fish Constructors, Inc., out of two division offices, at McComb, Mississippi, and Selma, Alabama. An office also has been opened at Newark, New Jersey, and pipe location and right-of-way acquisition work is now being done on the eastern section of the line, which will include the Hudson River crossing. It is contemplated that some pipe line construction will be performed on the eastern end this year between Linden, New Jersey, and the Hudson River.

Work also is beginning on five main line compressor stations. These are Station No. 6 situated just south of St. Francisville, Louisiana; Station No. 9 near Linden, Alabama; Station No. 12 approximately 10 miles south of Atlanta, Georgia; Station No. 15 situated approximately 15 miles north of Charlotte, North Carolina, and Station No. 8 about 10 miles north of Orange, Virginia. Compressor sta-

ANNOUNCING

NEW, IMPROVED

Available now from warehouse stocks at Tulsa, Houston or Waterville, Ohio. Standard roll widths: 4", 6", 9", 12" and 18". Standard roll lengths in a continuous roll (no splices) are 400 or 800 feet. Special widths and lengths on request.



Glass Fiber yarn increases the tear strength 300% over the old type mat.

Vitron*

GLASS FIBER

UNDERGROUND PIPE WRAP

The combination of VITRON Glass Fiber yarn with VITRON mat results in an inorganic pipe wrapping material with extremely high tensile and tear strength. Waste due to breakage during application is eliminated. Downtime on the Coating and Wrapping machine is reduced to a minimum. Excellent saturation characteristics and the increased strength assure you a faster and more uniform pipe coating and wrapping job.

WRITE FOR BULLETIN NO. V-69

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* *Manufactured by GLASS FIBERS, INC., Waterville, Ohio*

BENT SMOOTH AND FULL FORMED MAKING
CLEANING & PRIMING - DOPING & WRAPPING - A CONTINUOUS OPERATION
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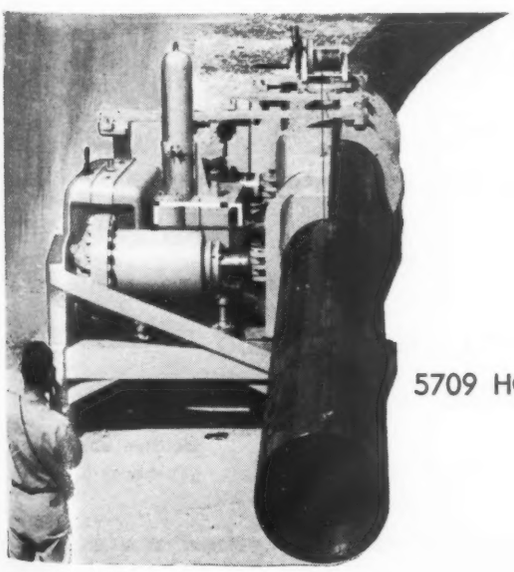
'Cinch' BENDER eliminates COSTLY 'KINKING' —

Gives the owner the pipe line he desires —

Gives the contractor better production methods and economy.

The 'Cinch' Bender makes pipe bending a cinch . . .



- CINCH SPEEDS UP PRODUCTION.
- CINCH REDUCES LABOR COSTS.
- CINCH ELIMINATES RISK IN BENDING.
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THE COODY BENDER COMPANY

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HOUSTON, TEXAS

Backhoes serve many useful purposes in pipe line work, being used principally to remove rock from ditch after blasting or dirt after caving.

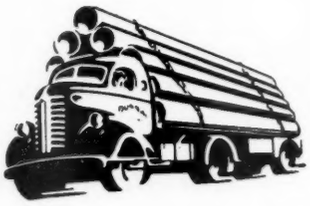
tions 6, 9, and 12 will have 12,000 hp, each containing five 2400-hp Cooper-Bessemer compressor units. Stations 15 and 18 will be of 11,200 hp each, consisting of seven 1600-hp Clark compressor units for each station. The stations will be complete in all respects as self-contained installations having their own electric generator units, water systems, etc., and it is expected that they will be completed by the end of the year. Work on other stations likely will not be started until the late Fall of this year. A total of 20 stations are to be constructed for the project.

Bids are now being received for the Coosa River crossing, which will be a bridge type crossing, and for the Tombigbee and Pearl rivers, which will be submerged crossings. Specifications are being released and bids will be taken on the Mississippi River crossing, which will consist of a submerged crossing using two 24-in. lines. Likewise specifications on design are being submitted to bidders on the Atchafalaya River in Louisiana, which will be an aerial bridge type crossing. It is contemplated that construction of these river crossings will be accomplished as a part of the 1949 construction program.

The rest of the pipe line system, consisting of main line, lateral lines both for supply and sales, measuring stations, other river crossings, the remaining compressor stations, dehydration plants, etc., will be constructed during 1950. According to present plans such work will be completed in time for gas to be delivered at eastern sales terminals during the late Fall of 1950.

Although it is now too early to give an account of what the difficulties of construction may be, a visit to the work during its early stages revealed some interesting operations. One of these is the double-jointing of pipe which is being done on part of the spreads. The pipe is received in 31.12-ft joints, and to reduce the number of field welds these are being double-

DUNN BROS.



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Authorized Operations

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A TWIN ENGINE BEECHCRAFT AND A RYAN NAVION ARE AT YOUR DISPOSAL AT ALL TIMES FOR A QUICKER LOOK AT YOUR STRINGING PROBLEMS.

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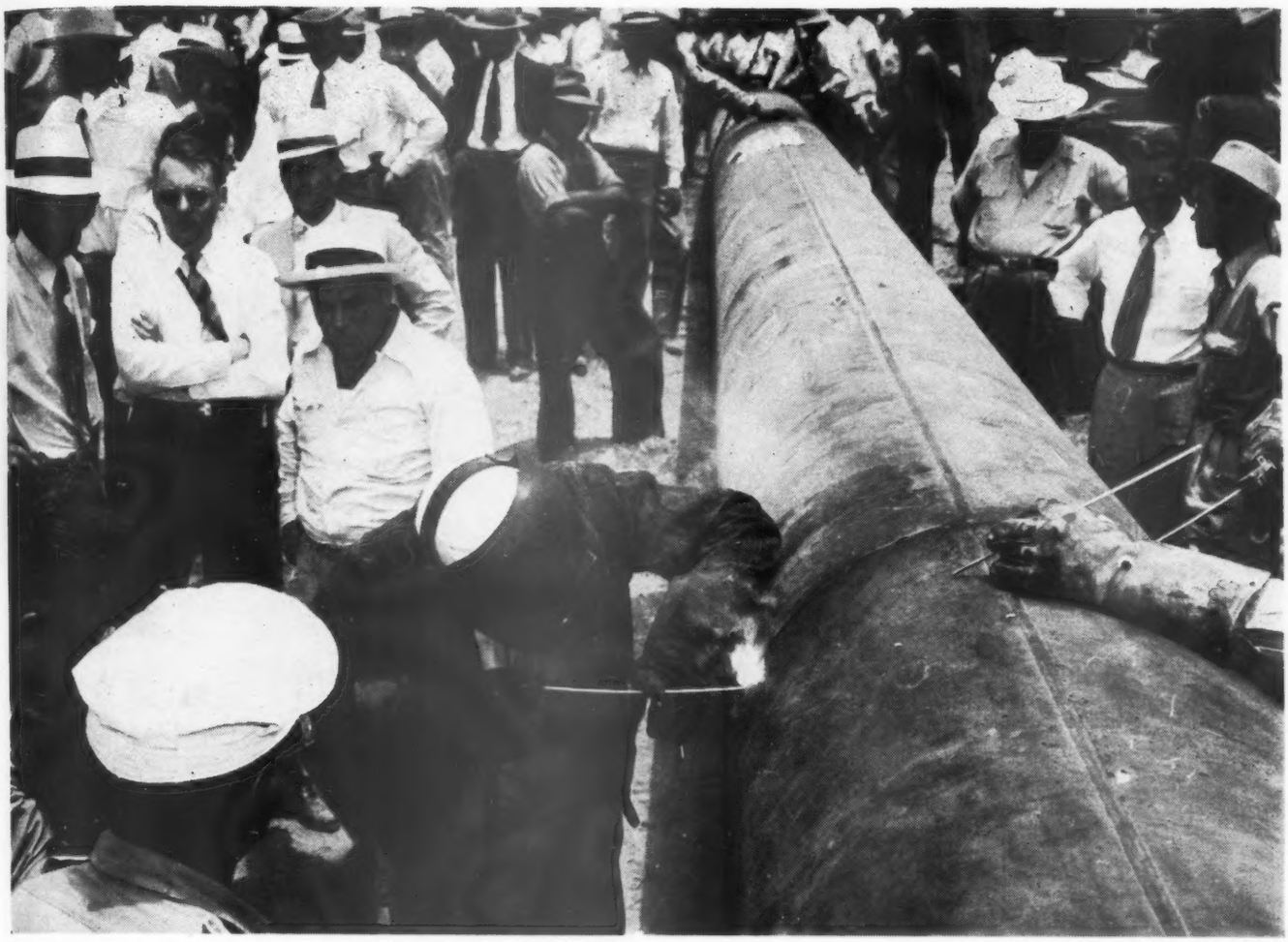


We Were There . . .

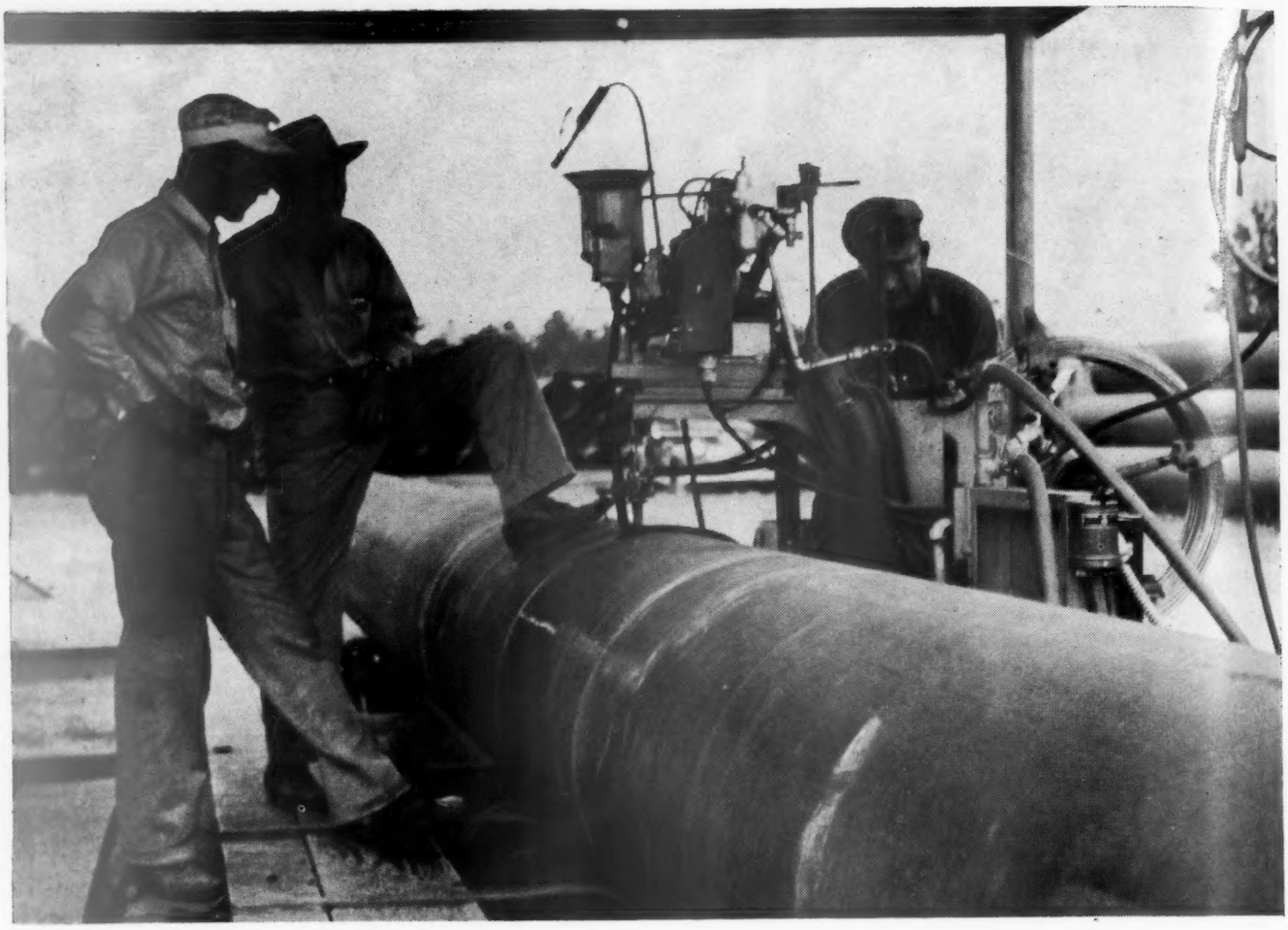
At the May 23 official ceremonies marking the beginning of construction of the Transcontinental Gas Pipe Line at Laurel, Mississippi (where the above scene was photographed), we were present to take part. We are doing the stringing for Wunderlich & Griffis Construction Co. on their section of approximately 112 miles of 30-inch pipe. For Transcontinental Gas Pipe Line Company we are unloading and racking some 425 miles of 30-inch between Eunice, La., and Danville, Ga.

Also we are stringing 122 miles of 26-inch for Associated Contractors & Engineers on the Texas Eastern Transmission Corporation line from Lebanon, Ohio, to Lancaster, Ohio, and 105 miles of 26-inch for Latex Construction Co., on the Texas Gas Transmission Co. line.

J. O. "RED" WILLETT

PIPE LINE STRINGER

MONROE, LOUISIANA



Because the pipe was in short joints (31.12 ft) a part of it was double-jointed in central yards by Shamrock Construction Company. The submerged arc-welding process was employed, its first use in the field on a pipe line job.

The line will be coated and wrapped throughout its entire length. Tractors equipped with pipelayers cradle the pipe as the coating and wrapping machine moves along on this Wunderlich & Griffis spread.

In traversing 1839 miles of main line and some 400 miles of laterals all types of terrain will be encountered, necessitating thousands of pipe bends. This is the type of bending equipment that is being used.

jointed in central yards using the submerged arc welding process. Although the process has been used in industrial plants for many years, this is the first attempt to employ it in the field on a pipe line job. In this method the stringer bead is run manually, after which the pipe is rolled into the automatic submerged arc welding machine where it is rotated as welded. After the two joints are welded the 62-ft section is stacked to await loading onto stringing trucks. The double-jointing work is being done by the Shamrock Construction Company of Chetopa, Kansas. The yard layout, including welding head, pipe rolling rigs, fit-up jigs, discharge conveyors, yard racks, etc., was provided by Reed Engineering Company, Carthage, Missouri. One machine can make 8 welds an hr, whereas the speed for manually made welds on this diameter pipe is 2 per hr.

Another interesting operation is the making of highway and railroad crossings. A comparatively new type boring machine is being used in which the augur head works through and just in front of the casing. The augur brings the dirt back through the casing, which is forced ahead as the hole is dug. In this manner the casing is in place as soon as the crossing is dug and the danger of caving is eliminated.

In fact, the Transcontinental project has been and is being given top engineering, and it isn't hard to understand why this would have to be so when it is considered that 2039 miles of pipe will be laid, 76 rivers crossed including such major ones at the Mississippi and Hudson, as well as innumerable railroads and highways, and more than 5000 separate tracts of land traversed.

Since the early part of February trainloads of pipe have been moving from the pipe mill at Maywood, California, of Consolidated Western Steel Corporation and stockpiled along the route of the line. Altogether approximately 25,000 carloads — more than 470,000 tons—of finished steel pipe will be required. Consolidated Western is fabricating the 26 and 30-in. pipe. The 20-in. main line pipe, 6-in. to 16-in. lateral line pipe, river crossing pipe, and miscellaneous smaller pipe, is being fabricated by A. O. Smith Corporation of Milwaukee, Wisconsin.

The Transcontinental line originates in and traverses one of the richest sources of natural gas in the world. Estimated reserves in the area total 90 trillion cu ft. The line will take gas from the following fields: Conoco-Driscoll, La Gloria, West Gueydan, Starr County, Odom, Lube and Petronilla, Lacy, Quinto Creek, Bee and Live Oak counties, North Markum and North Bay City, Egan, West Bernard, Fresh Water Bayou, and surrounding areas in Texas and Louisiana.

Delivery of gas will be to the following utilities: Consolidated Edison Company of New York, Public Service Electric and Gas Company of Newark, New Jersey, The Brooklyn Union Gas Company, Philadelphia Electric Company, Long Island Lighting System, Elizabeth Consolidated Gas Company of Elizabeth, New Jersey, Kings County Lighting Company, and Brooklyn Borough Gas Company. ***

Before pipe laying could begin it was necessary, of course, to clear the right-of-way. The bulldozer cleared extensive areas that were heavily wooded.

Design of Trans-Arabian Pipe Line*

S. P. JOHNSON†

PART 1

THE intent of this paper is to outline the principal features of the design of the Trans-Arabian Pipe Line that may be of interest to engineers connected with other large pipe line projects, and also to point out a few of the more interesting and unusual problems of construction.

The main problem of construction that distinguishes this line from a similar project in the United States is, of course, the remote location and the very large supporting organization that had to be organized to back up the actual construction staff. A few of the engineering problems, however, are also somewhat unusual.

In order for one to understand the design of this line, or at least the basis for many of its features, it seems advisable to review the history of the project in a general way. The Trans-Arabian line was first considered as a probable future venture several years before the war. Serious thought to its immediate construction, however, started in the latter part of 1943 when the U. S. Government considered the construction of such a line as a war measure. Little was known about the character of the country at that time, and it was not known whether it would be more desirable to terminate in Palestine, perhaps at Haifa where one branch of the Iraq Petroleum line terminates, or to adopt the somewhat longer route into Egypt. At that time the largest pipe available in the United States with suitable properties for pipe line construction was 26 in. OD. This pipe was fabricated by an electric welding process from steel plate, which, at that time, was scarce. It seemed quite probable that if a line were built it would have to be built of 24-in. seamless pipe, just as the Big Inch Pipe Line had been. This was the largest suitable seamless pipe available at that time. Tentatively, a working stress of 65 per cent of the minimum yield point based on the nominal thickness without corrosion allowance was deemed proper, especially since the Big Inch line had performed satisfactorily when operating under these stress conditions. The possible variations in the thickness from nominal were ignored, simply being included in the factor of safety, as were allowances for corrosion. Experience had amply demonstrated that, except in very special circumstances, corrosion allowances have little if any place in the design of a pipe line for crude oil. Normal crudes do not corrode the pipe, and such failures as may take place from soil corrosion outside are normally perforations, which result in leaks but seldom if ever in breaks, since they have little effect on the overall strength of the pipe. In this case, it was hoped to avoid any serious external corrosion by good wrapping and cathodic protection where the line is buried.

A capacity of 300,000 bbl per day was tentatively decided on, largely because this is close to the maximum quantity that can be put through 24-in. pipe without excessive pumping costs, and partly, perhaps, because it seemed that production of about this magnitude might be expected in the eastern part of Arabia by the time the pipe line could be constructed. The proposal of our government to build a pipe line was very seriously considered in 1943 and 1944 but was finally given up, no doubt largely because by the middle of 1944 the war had progressed to a point where it was fairly evident that it would be all over, as far as Europe was concerned, before a pipe line project could be completed. However, The Texas Company and the Standard Oil Company of California, who at that time were equal partners in the Arabian concession,† authorized some preliminary engineering investigation, and after a reconnaissance at the end of 1944 their engineers recommended a route that, to all intents and purposes, is that indicated in Fig. 1 and is the route that is now being followed in the construction of the line.

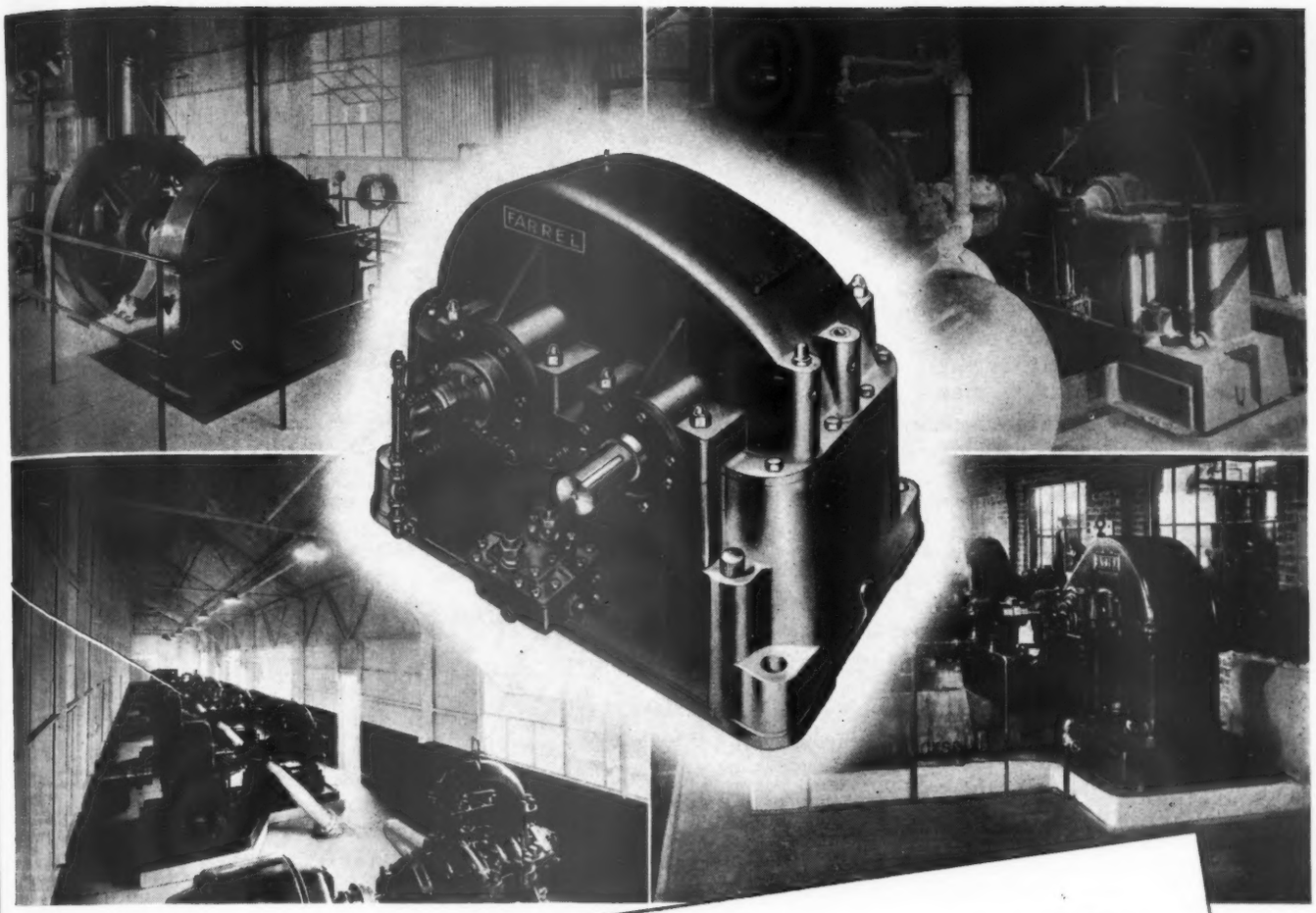
When the war was over the same considerations that had prompted the government to consider the construction of a pipe line continued to urge its construction by private industry. The case can be stated very briefly. The length of the line from eastern Arabia to the Mediterranean is between 1030 and 1070 miles, depending on the route selected, (the surveyed distance on the present route is 1067.5 statute miles) whereas the tanker haul around the Arabian Peninsula and through the Suez Canal to Port Said is 3167 nautical miles or 3650 statute miles. It was estimated that about 62 tankers of the T-2 type would be required to handle 300,000 bbl per day around the Arabian Peninsula. Between 60 and 80 tankers of this type or larger would be needed to handle the capacity of the pipe line now projected. These tankers were not available, and to construct them would unquestionably have required more steel than the pipe line, although the two figures for steel tonnage do have the same general order of magnitude. Also, pipe line steel requires less fabrication than the same tonnage in ships. As to cost, it was believed that the total cost of pipe line transportation would be substantially less than the expense of taking the oil around to Port Said by tanker. Sharp increases in cost of material and labor and other difficulties have since then increased the cost of the pipe line somewhat. Since the same increases have affected new tankship construction, the overall advantage of the pipe line is still substantial, though probably somewhat less than originally estimated.

When the design of the pipe line was re-examined in 1945 at the close of the war, it became clear that the 24-in. pipe was somewhat too small for best economy, and that for a nominal average rate of 300,000 bbl per day (with some allowance for lost time) a thin-wall pipe of approximately 30-in. diam would be preferable, and it was hoped that it might be possible to procure such pipe after the war when the steel mills were somewhat less flooded with business and perhaps able to construct new facilities. Actually, the procurement of pipe turned out to be very difficult. The reason for mentioning this is that it affected the design of the line. The designers had to be guided by what could be had, as well as by what might be wanted. The pipe that is being used seems to be very satisfactory, however, and is believed to represent a

*Presented before Petroleum Division, The American Society of Mechanical Engineers, San Francisco, California, June 27-30, 1949, under the title "Some Features of the Engineering and Design of the Trans-Arabian Pipe Line."

†Engineer, Standard Oil Company of California.

†Present ownership: 30 per cent California Standard, 30 per cent The Texas Company, 30 per cent New Jersey Standard, 10 per cent Socony.



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good solution to the problem. The pipe has been, and still is being manufactured at Maywood, California, from plate rolled at Geneva, Utah. Half the pipe is 30 in. in diam and half 31 in., and most of it has a nominal wall thickness of ¼ in. The steel is a medium carbon, medium high-manganese material, and is semi-killed. Specification limits are as follows:

	Per cent
C	0.30 max.
Mn	0.85 to 1.25
P	0.045 max.
S	0.05 max.

In general, most of the pipe actually runs about 0.25 to 0.26 carbon and about 1.0 manganese.

Pipe Fabrication

When the plate arrives at Maywood it is planed to exact size, rolled, and welded inside and out by the "Union-Melt" process. As fabricated the pipe is about ½ in. undersize in diameter. After fabrication it is put into a heavy steel die and expanded under hydraulic pressure into its full size. This expansion of course stretches the steel beyond the yield point, and the cold work makes a significant increase in the tensile strength, especially in the circumferential direction. The specifications call for the pipe after expansion to have a minimum circumferential yield strength of 52,000 psi and an ultimate of 65,000 psi. Both figures are consistently exceeded and most of the material shows a yield strength over 60,000 psi. The expansion apparently causes a gain in yield strength of between 12,000 and 20,000 psi in the circumferential direction, and perhaps half as much in the axial direction. The cold work also increases the ultimate strength of the metal in the circumferential direction by as much as 3000 to 7000 psi; this effect may not be generally known.

After being expanded, the pipe is tested hydrostatically to 90 per cent of the minimum specified yield strength of 52,000 psi.

The reason for making half the pipe 30 in. and half 31 in. was to permit it to be telescoped to save shipping charges. It is impossible to load a cargo ship to more than a third its deadweight carrying capacity with large, thin-wall pipe.

With pipe fabricated as outlined, the design basis for the pipe line was taken as 65 per cent of the nominal yield point based on nominal thickness, stresses being computed by the conventional outside-diameter or Barlow formula. Such a procedure gives an allowable working pressure of approximately 570 psi for 30-in. pipe having a nominal ¼-in. wall thickness. When the pipe line was laid out

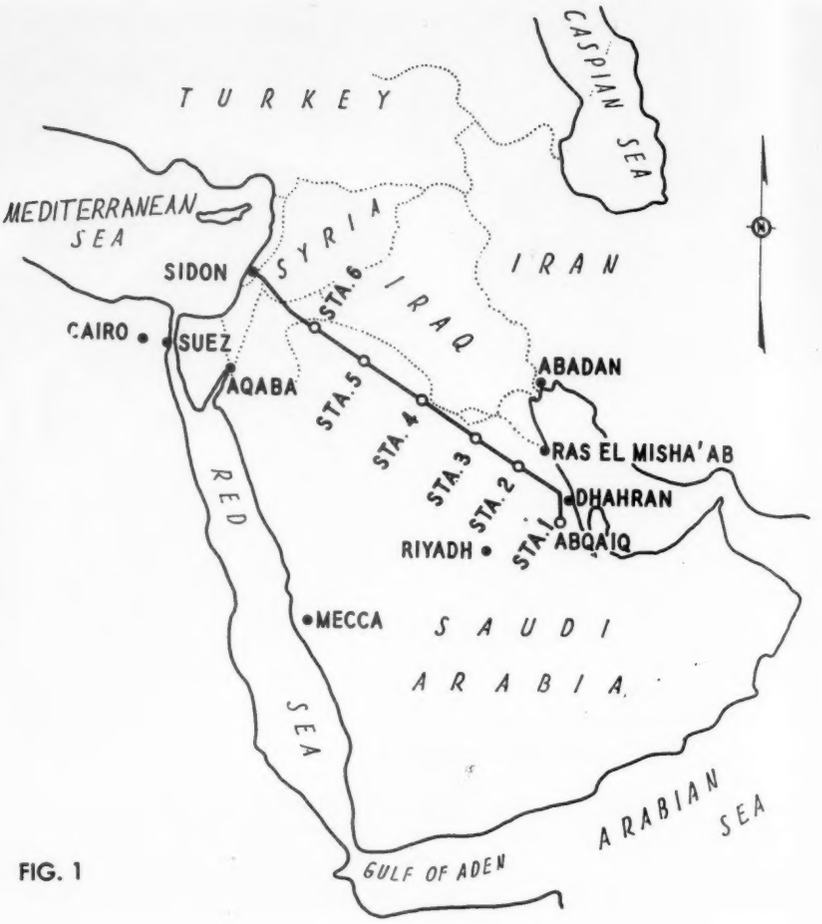

FIG. 1

on the basis of a minimum flow of 315,000 bbl per operating day (300,000 bbl per average day) and ¼-in. wall thickness, it was found that at least eight pumping stations would be required, but by increasing the wall thickness of the pipe at the high pressure part of the line to a maximum of 7/16 in. the working pressure could be increased to 885 psi, and by this move it was possible to reduce the number of stations to six. When it is realized that each pumping station is not just a small building with some pumps deriving power from a utility line, as they were on the Big Inch project here, but instead a new community out in the desert that has to be supplied with everything from the outside, this advantage can be seen in its true proportions. A community of this kind not only has to be self-sufficient so far as Americans and a much larger number of Arab employes are concerned, but whether or not one plans it that way, it will inevitably attract a large number of hangers-on from the Bedouins in the vicinity who will, if nothing more, at least expect to use the water that the company develops to take care of their flocks. The total number of persons to be supported directly or indirectly by the station facilities is suprisingly large to one accustomed to similar operations here at home. Moreover, to procure and retain a competent American operating staff in a location hundreds of miles from the nearest settlement of any size, the pipe line company must provide recreational and other facilities far beyond those needed here or in Europe.

Terrain

The northern plains of Arabia slope gently upward from east to west at a fairly uniform rate, reaching a summit in Trans-Jordan only a little more than a hundred miles from the Mediterranean Coast. The maximum elevation on the pipe line is nearly 2900 ft at Milepost 785, but the controlling elevation for the line originally laid out was only about 2200 ft and was at about MP 1025.

At approximately MP 1032 the right-of-way plunges precipitously into a valley some 13 miles north of Lake Hula, descending to an elevation of 740 ft at MP 1042. This valley is the northern extension of the Jordan River drainage. Lake Hula drains into the Sea of Galilee about 12 miles to its south. The pipe line crosses the north end of the valley proper, although the river, still called the Jordan, or Nahr el Hasbani, extends some miles to the north in a narrow and broken canyon.

From here the route crosses a spur of hills, reaching an elevation of 1600 ft 5 miles from the valley floor, and

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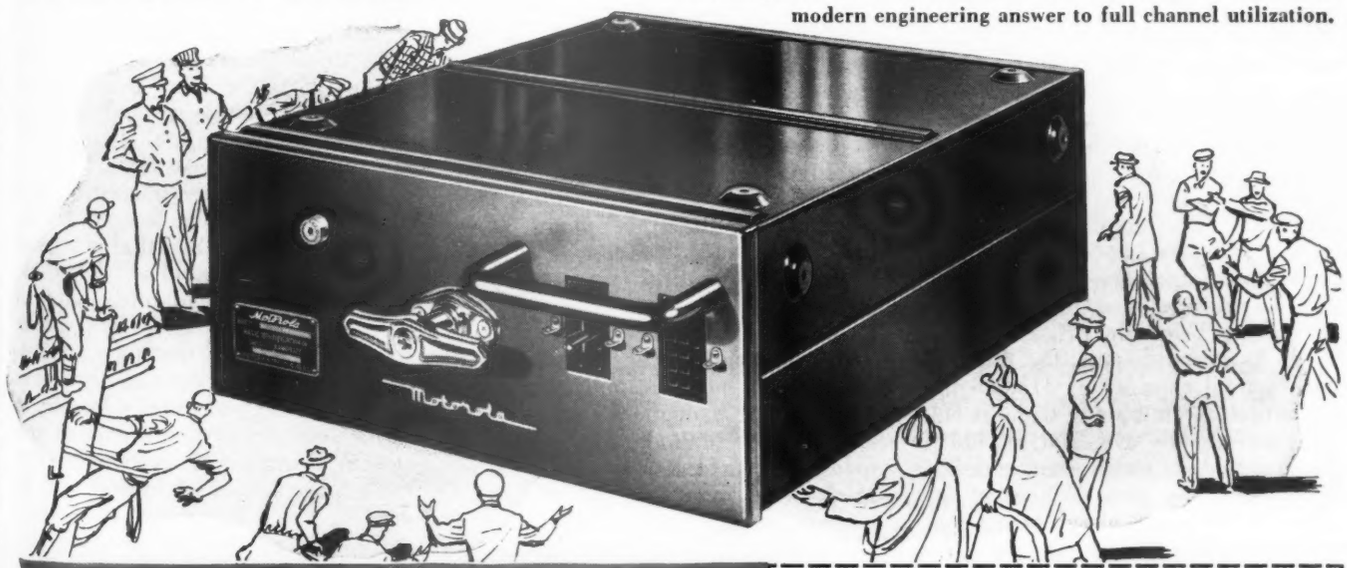

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again descends to the Nahr el Litani at MP 1052, elevation 700 ft. (Nahr = small river) This river drains the Beqaa Valley in Lebanon, but turns sharply westward and empties into the Mediterranean 8½ miles south of Sidon instead of entering the Jordan.

The pipe line again climbs to an elevation of 1700 ft across the southernmost spur of the Lebanese mountains, descending over 1000 ft to the terminal in the last four miles. There is obviously an excess of pressure to be used up in this section, and it was deemed necessary for safety to have the pipe line capable of withstanding the maximum hill pressure (some 2500 ft) under static conditions. Of course a turbine for recovering the several hundred horsepower that would be available under certain conditions was thought of, but it did not look like a promising complication.

While miles and feet are spoken of here, the surveying has actually all been done in meters, and the maps are drawn to a natural scale. This has been found to be very convenient.

Although the pipe line was, as indicated, designed for six pumping stations, it began to appear (well after construction had actually begun) that a larger capacity than 300,000 bbl per day might be wanted badly, and, further, that obtaining more steel pipe for looping the original line would probably be all but impossible during the next two years if the steel shortage continued. Only a few months ago, therefore, the heavy and light pipe was reallocated so as to permit the addition of intermediate pumping stations, which would make the total number of pumping stations ultimately 12. This results in some unbalance when the line is operated with six stations, and also results in cutting the pressure of several of the first six stations below the original design limit. As it stands now, the line will have a total capacity of 315,000 bbl per actual operating day with six stations and slightly over 500,000 bbl if the intermediate stations are added.

Now that the press in general has taken so much note of events and conditions in the Middle East, and so many people have actually been there either as employes of the oil companies, civil construction forces, or the military forces, the average American has a much better conception of Arabia than he might have had 10 or 15 years ago. Nevertheless, it probably remains a fair guess that the picture many people have of Arabia is a wilderness of sand, with perhaps a little water hole or well here and there supporting a few date palms. In a way this conception is not too had for a part of the country. In fact, just to the north of Abqaiq where the major oil production of Arabian American Oil Company is now located, and covering a part of the field, there are sand dunes close to 100 ft high, which move southward at rates approximating 50 ft a year over a base of chert. These dunes are indeed a serious obstacle to construction, but they are almost entirely confined to the first 40 miles of the line between Abqaia and Qatif. As a matter of fact, the moving dunes probably cover less than a third of even this section. The line here was the first to be completed, and has been in successful operation for some time, handling oil to Qatif Junction whence it is delivered to the coast for loading ships pending the completion of the entire line.

An overwhelming proportion of the right-of-way is either not sandy at all, or is covered with a stable sand or sandy soil that supports a growth of small bushes and does not tend to shift. This latter type of terrain, largely confined to the first 150 miles of the line, has been found excellent for pipe line construction and road building.

Farther to the west the terrain for many miles consists of flat rock and gravel plains, virtually treeless except for a few spots, but supporting an intermittent and sparse growth of grass on which the Bedouins graze their flocks of sheep, goats, and camels during favorable parts of the year. Some of the gravel plains are underlain with a material apparently containing a considerable proportion of gypsum. This appears quite hard on first examination, but it can be handled with a ditching machine. The worst part of the gravel plains, however, is that the truck tires quickly get through the thin layer of gravel and reduce the underlying material to an almost impalpable powder, which makes hauling difficult. A great deal of the rock plain is underlain with limestone at a depth that may vary from almost nothing to several feet below the surface. This limestone is fairly hard, and some of it is extremely hard.

Certain portions of the plain country are extremely rough, the surface being covered with fractured stone piled up in irregular heaps, making it almost impossible for road or other construction, even though it looks quite smooth from an airplane at an elevation of 1000 ft. Fortunately, however, it has been possible to avoid nearly all the worst of this country by adjusting the route slightly.

This plain country is traversed by dry washes known as wadis, which, in general, slope toward the north. The word "flow" is intentionally omitted, for most of them are dead wadis that never reach the Euphrates River and have not actually discharged any water there for probably many thousands of years. However, water does run in them at times for some distance; they do collect water and accumulate moisture, and are sometimes filled with surprisingly lush vegetation in the early spring. They offer no serious constructional difficulties.

When the line approaches Trans-Jordan at about MP 860 it enters the well-known Trans-Jordan lava beds. Road construction here is moderately difficult. The lava beds themselves are quite different from what one might believe from looking at the maps or from a casual examination. Much of the lava has weathered into a yellow sand, but there are large boulders covering almost the entire surface. Below the surface there is a mixture of sand and boulders. A fair road can be made by sweeping away the surface boulders, provided enough binding material can be brought in to stabilize the sand and keep it from blowing away. Sub-surface boulders, however, make ditching operations difficult.

Beyond the lava beds the right-of-way enters country that becomes more and more built-up. Occasional settlements and villages with permanent structures come into evidence. Flowing streams develop and patches of soil, carefully terraced and intensively cultivated, are interspersed with rocky hills. Beyond the lava beds the right-of-way skirts the Jebel Druse, a volcanic butte that is a landmark for miles around, and finally drops into the valley above Lake Hula.

There is one other interesting type of country that a pipe line must cross in Eastern Arabia, and that is the salt bogs known as "sabkhas." They are permanently wet and often have an almost absolutely flat surface, giving one the impression that they are natural pools of salty water that have blown full of sand, finally forming a stable surface just damp enough and smooth enough to prevent more dry sand from adhering. Indeed, that is what they are. Sometimes the surface of a sabkha is covered with loose sand of varying depth. They are always wet under the surface, and the crust may be anything from damp to very dry, depending on the location and the season of the year. Sabkhas are all confined to the general vicinity of the Gulf Coast, but the pipe line crosses several of them, some of which are fairly large. They are treacherous for automobile and truck transportation, but a good road can be constructed by proper grading and by bringing in some outside material.

Part 2 will be published soon.

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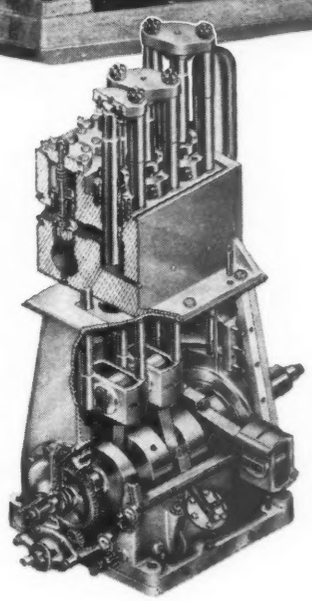

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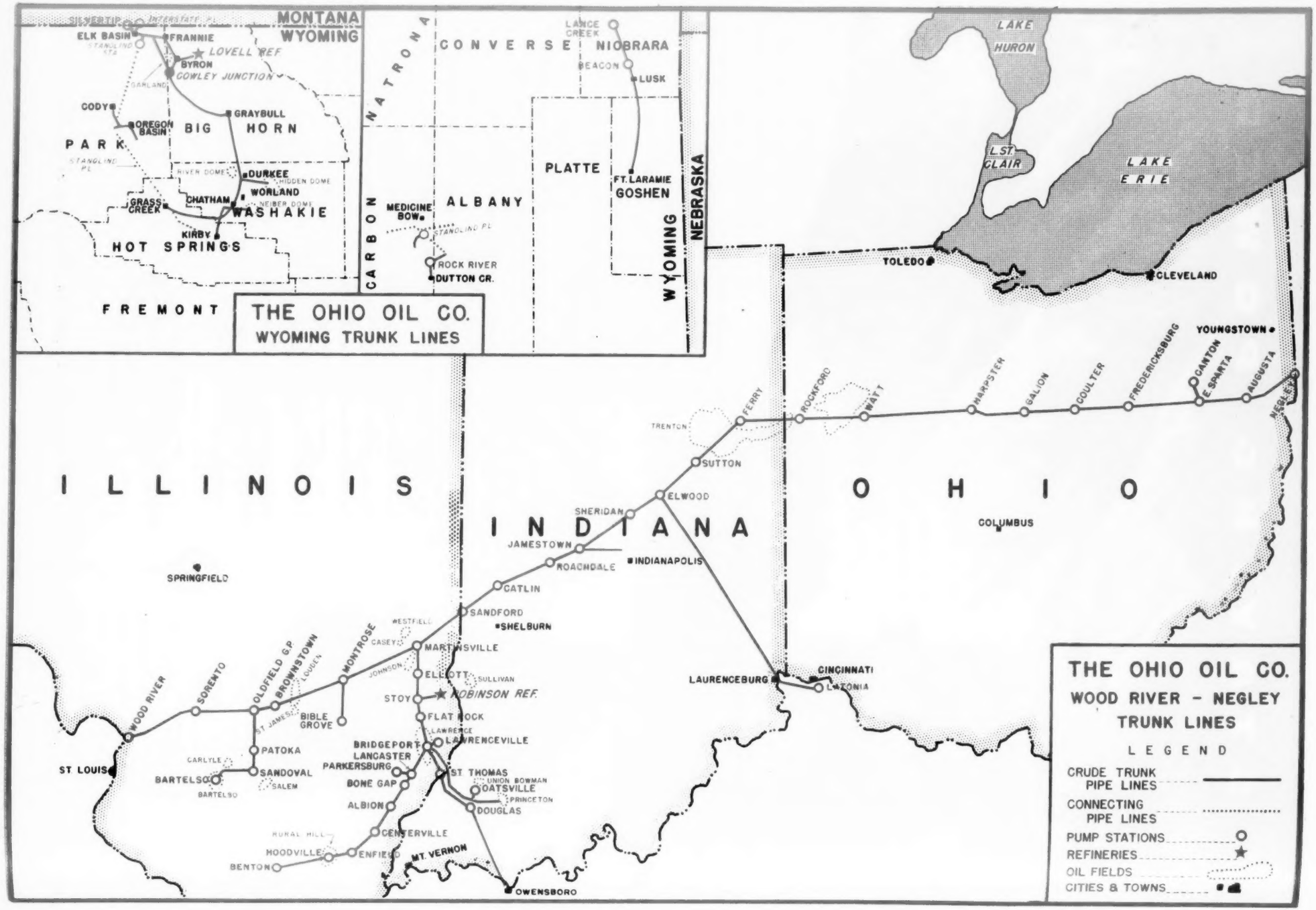

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NEWS

Basin-Ozark Pipe Line Systems Dedicated

The Basin and Ozark Pipe Line Systems, together comprising the largest crude oil pipe line ever built by private capital in America, were formally dedicated on July 12 at Cushing, Oklahoma.

Walter S. Hallanan, president of the National Petroleum Council, was the principal speaker.

Stretching 1000 miles from Jal, New Mexico, via Cushing, Oklahoma, to Wood River and Patoka, Illinois, the completed lines provide an important artery of transportation for crude oil from the oil fields of West Texas and New Mexico to the refining centers of the Mid-West.

The Basin Pipe Line System, a combination of 20, 22, and 24-in. diam pipe stretching 515 miles from Jal to Cushing, has a capacity of 241,000 bbl of crude oil a day, and the Ozark System connecting with it at Cushing and continuing on to Wood River and Patoka, Illinois, of 22-in. pipe throughout, will handle 186,000 bbl a day.

The two new systems are projects of four companies, financed by themselves without subsidies of any kind. The Basin System built by The Texas Pipe Line Company is owned and will be operated on an undivided interest basis by it and Shell Pipe Line Corporation, Sinclair Refining Company, and Empire Pipeline Company. The Ozark System, built by Shell Pipe Line Corporation, is owned by it and The Texas Pipe Line Company, while the 54-mile extension to Patoka, Illinois, is owned by the latter. At Cushing, Oklahoma, and Patoka, the systems connect with systems of other carriers by pipe line.

The Basin line has eight main line pump stations and the Ozark line has five. All embody the latest design with electrical motor-driven centrifugal pumps and automatic controls.

In connection with the opening of the two systems, there was an extensive tour of stations beginning July 11, at Wichita Falls, a barbecue and dedication ceremonies at Cushing, a dinner that evening in Tulsa, Oklahoma, followed by a further tour on to Wood River, Illinois.

Pipe Liners Club To Meet in Cushing

The Pipe Liners Club of Tulsa will hold its July meeting in Cushing, Oklahoma, it has been announced. The exact date is July 18. A part of the program will be a field trip. The new station on the Ozark Pipe Line System, which is about two miles south of Cushing, will be visited. Also open for inspection will be the manifold of the incoming Basin Pipe Line System. The Ozark Pipe Line System is owned jointly by Shell Pipe Line Corporation and The Texas Pipe Line Company. It was designed, constructed, and is being operated by Shell. The Basin System is owned jointly by Texas, Shell, Sinclair Refining Company, and Empire Pipeline Company. It was designed, built, and is being operated by Texas.

In the evening, following dinner at the Cushing Hotel, a paper will be presented by H. H. Anderson, vice president and general manager of the Shell Pipe Line Corporation.

Dates Set for Corrosion Engineers' Annual Tour

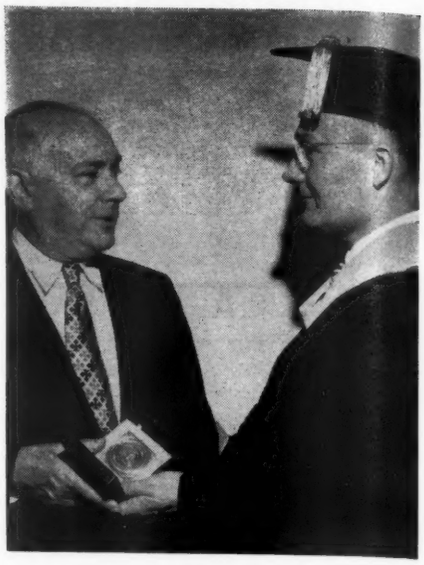
The West Texas chapter of the National Association of Corrosion Engineers will hold its fourth annual corrosion tour September 27, 28, 29, and 30. In addition to the tours, which will be held each day, three outstanding corrosion engineers will deliver papers, and there will be a manufacturers' exhibit. The tour and meetings are open to anyone interested in corrosion problems.

Rotterdam Oil Port Facilities Progressing

Construction is rapidly progressing at Rotterdam on projected expansion and improvement of the oil port to enable the largest tankers to discharge cargoes with the quickest dispatch. The center of this port is being formed at the second petroleum haven, which groups itself with the existing industries situated at the first petroleum haven, which now has a depth of approximately 33 ft, and particularly around the new refinery of the Caltex Company.

Preparatory work for extension of the number of tank installations and construction of quays for the accommodation of vessels was initiated in 1946 and the following year work was started on the construction of a pumping house.

Last year the need for tank space was so great that the first cargoes of oil fuel and gas oil could be received only by an emergency installation. Installation of the second pumping house is already underway. Following the establishment of the Dutch Storage Company installation, tankers have been able to arrive regularly and discharge with quick dispatch.



H. C. Price (left) receiving the distinguished achievement medal of the Colorado School of Mines from President Ben H. Parker.

H. C. Price Honored by Colorado School of Mines

Harold C. Price, president of the H. C. Price Company, Bartlesville, Oklahoma, was one of 12 outstanding graduates of the Colorado School of Mines, Golden, Colorado, to be awarded the distinguished achievement medal at the 75th commencement of the school. The award to Price was made for achievement of distinction in the fields of pipe line engineering and construction and business management.

In addition to the recognition accorded him in the ceremonies, Price was an honored guest of President Ben H. Parker at a luncheon for the recipients of the awards at the Denver club on Thursday preceding the commencement and the annual president's luncheon on commencement day. He was also one of those receiving special recognition at the annual alumni banquet on Thursday.

Price received the engineer of mines degree from the Colorado School of Mines in 1913.

Cuyama Pipe Line Laid in Two Weeks

A 30-mile, 8-in. crude oil pipe line connecting the new Cuyama Valley field, California, with Richfield Oil Corporation's San Joaquin-Maricopa pipe line was completed in 14½ days. Eleven miles of the route was through mountainous terrain, involving considerable extra work. The new line replaces the temporary 6-in. line laid soon after the field was discovered.

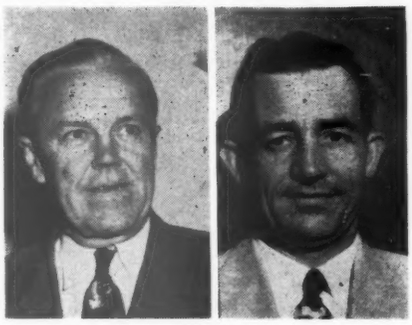
Stanolind Pipe Line Organizes Purchasing Department

Organization of a purchasing department for the Stanolind Pipe Line Company, under the supervision of Hubert L. Drake, is announced by J. L. Burke, president. The new department was activated July 1.

Procurement for the pipe line company, one of the world's largest, was performed jointly with the Stanolind Oil and Gas Company until the new unit was organized. Charles D. Wells, a buyer for Stanolind Oil and Gas Company, will be transferred to Stanolind Pipe Line as Drake's assistant.

The new department will have offices at present on the second floor of Tulsa's Atco Building, and will have charge of the procurement of all Stanolind Pipe Line Company requirements, both locally and in its operational areas. The company's lines traverse 11 states and it operates large gathering systems in five states.

Drake, a senior engineer who advanced to his post from a job he took with the company in 1933 as a laborer, is a graduate of Oklahoma A & M College, where he took a B.S. in mechanical engineering. His first job with the company was in the Tulsa machine shops. Promoted to a third class machinist, and then to machinist's helper, he worked at Drumright and Hominy stations. After being advanced to a junior engineer, he assisted with the installation and maintenance of tank gauges and flow meters throughout the company's system. He also traveled extensively over the system with a machinist crew that erected pump station equipment.



Charles D. Wells Herbert L. Drake

In 1939, Drake returned to the Tulsa office as a draftsman and soon was elevated to engineer-draftsman. Commissioned a lieutenant in the navy in 1942, Drake served at Memphis, Tennessee, as assistant public works officer at a naval training station. After 14 months at this post and a period studying aircraft engines, he was sent to England where he was in charge of a service unit on a squadron of PB4Y bombers on anti-submarine duty. He was made senior engineer in charge of mechanical engineering and structural and architectural engineering the next year after his discharge from the navy.

Wells, an employee of Stanolind Oil and Gas Company for 14 years, has been a buyer since 1946. Previously, he was employed in the accounting department. After attending the University of Oklahoma, Wells was employed first on a newspaper at Ranger, Texas. He later joined the Wyoming Corporation of the Prairie Oil and Gas Company, a subsidiary of the Prairie Oil and Gas Company, as a roustabout, and 10 years later became the assistant purchasing agent and finally the purchasing agent for the subsidiary.

North Texas Crude Oil Line Contracted

The Texas Pipe Line Company has awarded a contract to Latex Construction Company, Houston, Texas, to construct a 36-mile crude oil pipe line in North Texas, it was announced by R. B. McLaughlin, president of the pipe line company.

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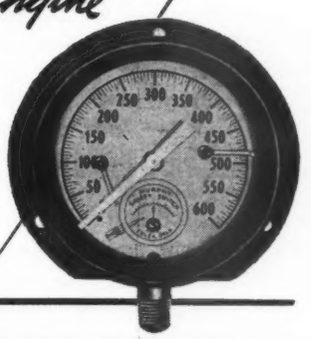

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CONROE, TEXAS

Pipe Line—Marine Transportation—Personals

Clyde A. Swigart

Ralph K. Paine

George W. Evans

S. V. McCollum

Ralph K. Paine has been appointed manager of the pipe line department of Standard Oil Company of California. He has been general superintendent of the southern California district of the pipe line department since 1946.

Paine succeeds **Clyde A. Swigart,** who has been elected a vice president of the Trans-Arabian Pipe Line Company.

Succeeding Paine as southern district general superintendent is **L. E. Joses. E. B. Saunders** will be superintendent of the southern district. Both will have headquarters at La Mirada. **E. J. Hyde** becomes superintendent of operations control for the department, with headquarters in San Francisco.

George W. Evans, who for the last 10 years has been general purchasing agent for Continental Oil Company, Ponca City, Oklahoma, has been appointed to the newly created position of coordinator of pipe lines and manager of purchasing, it has been announced by **L. F. McCollum,** president. Announcement also is made of the promotion of **S. V. McCollum,** assistant purchasing agent, to be purchasing agent, succeeding Evans.

In his new position Evans, in addition to having executive direction over purchasing, will coordinate activities of Continental Pipe Line Company as well as the activities of all pipe line companies that are subsidiaries or affiliates of Continental Oil Company.

Evans has been with Continental for nearly 27 years. He joined Continental as a price clerk in the purchasing department in 1922. After several promotions he became assistant purchasing agent in November, 1924, and was named general purchasing agent in November, 1939.

S. V. McCollum joined Continental Oil Company in 1939 as a roustabout at Eunice, New Mexico, and later became an engineering clerk at Eunice. Successive promotions took him to Hobbs, New Mexico, as a field engineer and petroleum engineer, and then to the Midland and Big Spring, Texas, areas as division petroleum engineer. He was named regional petroleum engineer at Fort Worth in June, 1947, and was promoted to assistant purchasing agent at Ponca City in February, 1949.

In announcing the promotion of S. V. McCollum it was stated that he is not related to L. F. McCollum, president of Continental Oil Company.

Wayne Adair has been appointed district foreman at Paullina, Iowa, by the Northern Natural Gas Company. He succeeds **Chub Shearon,** who resigned to take up farming.

M. W. "Mike" Hanna, superintendent at the Petrolia, Kansas, compressor station of Cities Service Gas Company, met with a tragic death recently. Mike was killed when he came in contact with electric power lines that had been blown down during a windstorm. Returning home alone from Chanute his car is believed to have become entangled with downed high-voltage lines and when he tried to step from the car to the ground outside he was electrocuted. Hana began his service with Cities Service Gas Company in 1915.

P. F. Kittell is the chief inspector for Northern Natural Gas Company on the North of Clifton loop. **P. T. McDonough** is chief inspector on the North of Ogden loop.

T. S. Llewellyn, assistant master mechanic, Stanolind Pipe Line Company, delivered a paper on "Torsional Vibration" before the June meeting of The Pipe Liners Club of Tulsa.

Ernest B. Jenkins, chief engineer at the Iowa compressor station in Southwest Louisiana of United Gas Pipe Line Company, passed away recently in the Calcasieu Parish hospital at Lake Charles after a brief illness. He was 63 years old.

Robert Friedman, acting head of the Oil and Gas Division of the U. S. Department of the Interior, has resigned that post to become assistant to **Ralph K. Davies,** president of Trunkline Gas Supply Company, with headquarters in San Francisco, California.

C. R. Ice, veteran of more than 24 years in pipe line construction, recently joined H. C. Price Company, Bartlesville, Oklahoma, pipe line constructors, as spread superintendent. Charlie has had a thorough grounding in pipelining. He started during the pick and shovel days as a laborer and worked his way up through the ranks to superintendent. In addition to having worked on some of the first oil and gas pipe lines in this country, he supervised the construction on sections of the Big Inch and Little Big Inch. More recently he was superintendent on large oil and gas pipe lines constructed for Magnolia Pipe Line Company and Tennessee Gas Transmission Company.

He has also had foreign service, having been field superintendent on pipe lines constructed in Colombia and Brazil, S. A.

His present location is at Petersburg, West Virginia, where he is supervising the construction of a 70-mile section of the 200-mile, 26-in. high pressure natural gas pipe line contract, recently awarded to H. C. Price Company by Atlantic Seaboard Corporation and Virginia Gas Transmission Corporation.

▸ **W. H. Baines,** head accountant of the United Gas Pipe Line Company in the Shreveport general office, has been retired under provisions of the employe's retirement plan. He was employed by a predecessor company October 1, 1928. Another employe to retire upon reaching the age of 65 is **John W. Morris,** engineer at the Bruni compressor station in the San Antonio district. His connection with the company dates back to 1925.

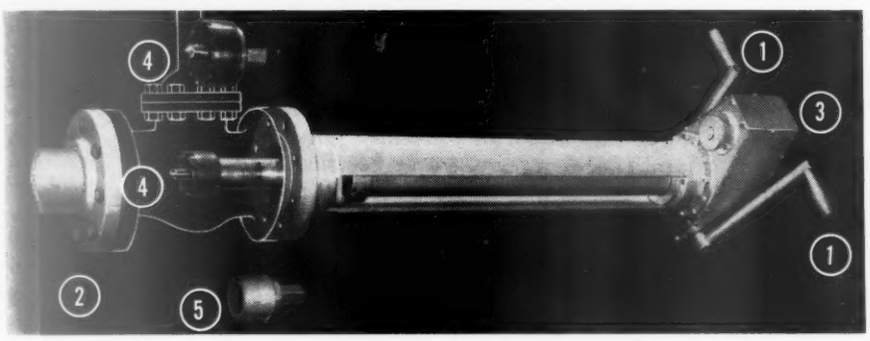
▸ **V. L. Red,** Midland, superintendent of the West Texas district for Magnolia Pipe Line Company, has been transferred to Olden as district superintendent. **C. C. Coffindaffer,** who has been superintendent of the Olden district, has been made district superintendent at Healdton, Oklahoma. **H. M. Van Buskirk,** district superintendent at Healdton, has been moved to Midland as superintendent of the West Texas district.

▸ **Charles Dunlap,** former Stanolind Pipe Line Company station engineer at Hufsmith, Texas, has been appointed area industrial relations supervisor for the company's West Texas division. He will have headquarters in the company's divisional office at Lubbock. C. E. Wilson, area superintendent of the West Texas division said Dunlap had been assigned to assist in industrial relations work.

Dunlap, born in 1904 at Holland, Texas, joined the Stanolind Pipe Line Company in 1931. Earlier he was employed by the Santa Fe Railway as a machinist apprentice and timekeeper, and by commercial firms in Tyler, Texas. From his Texas post, Dunlap was transferred in 1937 to Odessa, Missouri, serving as a station gauger. He later became an oiler and in 1942 was made station engineer at Hufsmith. Prior to his new assignment, he took a training course in industrial relations at the Tulsa headquarters.

▸ **William J. Wilkins,** chief engineer, Gulf Refining Company, Tulsa Pipe Line Division, Tulsa, Oklahoma, has been transferred to the Pittsburgh office of Gulf.

▸ **B. R. Ray** has been reelected president of Northern Natural Gas Company. Other officers reelected at a recent meeting of the board of directors are: **John Merriam,** executive vice president; **Hiram Carson,** vice president in charge of operations; **A. B. Dilworth,** vice president and controller; **B. H. Harper,** secretary; **Merrill Kullbom,** assistant secretary; **Harry Siert,** treasurer, and **Paul Severance,** assistant treasurer.



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Other Patents Pending

J. B. Harshman

▸ **J. B. Harshman** has been made manager of the eastern division of Fish Constructors, Inc., which company has the design and construction contract for the Transcontinental Gas Pipe Line Corporation. His headquarters are at 54 Edison Place, Newark, New Jersey. Harshman resigned as general manager of pipe lines for Utah Oil Refining Company effective May 10, which post he had held since January 1. Prior to that he had served more than 28 years with Stanolind Pipe Line Company and was general manager for three and a half years.

▸ **Walter James,** engineer at the Cronwell station, Oklahoma, of the Interstate Oil Pipe Line Company, has retired after completing 34½ years' service with the company. He was first employed in 1910.

S. D. Day

▸ **S. D. "Steve" Day** has formed the S. D. Day Company, 2017 West Gray Street, Houston, Texas, to operate as manufacturers' agents. The company will sell pipe protective materials and related products to the oil and gas industry. At present Day has national distribution for pipe line asbestos felt manufactured by the Ruberoid Company, and represents Griptite Anchors and the Stearns Electronic Holiday Detector. During the 20 years he has resided in Texas, Day has represented The Barrett Company and has been vice president of the Pipe Line Service Corporation.

With the PIPE LINE CONTRACTORS

Williams Brothers Corporation, National Bank of Tulsa Building, Tulsa, Oklahoma, expects to begin clearing work in August on the Transcontinental Gas Pipe Line Corporation job in Georgia, with actual pipe laying starting about September 1. This is Schedule No. 6 and will extend from Newman to Danielsville, Georgia. The pipe is 30-in. diam. On the Texas Gas Transmission Corporation line between Slaughter, Kentucky, and the Ohio River, two spreads are working. A total of 166 miles will be laid. The contractor's field offices are at Hardinville and Valley, Kentucky. Doc Burton is superintendent at the former and Whitey Martin at the latter.

N. A. Saigh Company, 510-12 American Hospital and Life Building, San Antonio, Texas, is laying 103 miles of 20-in. pipe for the Texas Gas Transmission Corporation between Carthage, Texas, and Sharon, Louisiana. Carl Doyle is the superintendent in charge of construction.

J. L. Cox and Son, (Stringing Contractors) P. O. Box 386, Raytown, Missouri, is stringing 39 miles of 26-in. pipe for the Panhandle Eastern Pipe Line Company near Boonville and Pleasant Hill, Missouri. The general contractor is C. S. Foreman Company of Kansas City.

Morrison Construction Company, P. O. Box 881, Austin, Texas, is laying schedules 1 and 2 on the Transcontinental Gas Pipe Line Corporation line and work is well underway. Schedule No. 1 extends from Eunice, Louisiana, to the Mississippi, a distance of 67 miles. Schedule No. 2 is from the Mississippi River to near Highway 42 in Mississippi, a distance of about 112 miles. Garry Morrison is in charge. In the vicinity of Spring, Texas, an 80-mile, 30-in. loop is being laid for the Tennessee Gas Transmission Company.

Fish Contractors, Inc.. M. & M. Building, Houston, Texas, acting as agents for the Transcontinental Gas Pipe Line Corporation, annouces that 612 miles of the 30-in. line from the Rio Grande Valley of Texas to New York City will be constructed this year. Three contractors are now at work: Morrison Construction Company, Midwestern Constructors, Inc., and Wunderlich & Griffis Pipe Construction Company. Bill Hall is superintendent of construction for Fish Constructors. The work is being supervised from two division offices, at McComb, Mississippi, and Selma, Alabama. K. C. Biedermann is division superintendent at McComb, I. W. Ussery division engineer, Robert H. Latham division engineer, Jos. T. Morriss chief inspector for Schedule 2, Thos. L. Plake chief inspector for Schedule 3, John C. Goes engineer for Schedule 2, and Neal Pinet engineer for Schedule 3. At Selma, Eldon V. Hunt is division superintendent, N. F. Trainor assistant superintendent and division engineer, C. M. Shepard division engineer, John M. Hayne river crossing engineer, J. B. Moore engineer for Schedule 4, J. O. Strawhun engineer for Schedule 6, R. A. Harman division chief clerk, B. C. Robison division material supervisor, H. C. Davis chief inspector, J. W. Booth inspector, C. C. Gayhart inspector, J. C. Smith coating inspector, W. C. Lipsey welding inspector, and J. B. Webb chief of survey party on Spread 4.

An office also has been opened at Newark, New Jersey, and pipe location and right-of-way acquisition work is being done on the eastern section of the line. J. B. Harshman is manager of the eastern division.

Bechtel-Price-Conyes, 220 Bush Street, San Francisco, California, began laying pipe the latter part of June on the 506-mile, 34-in. gas line of Pacific Gas and Electric Company, from Topock, Arizona, to Milpitas, California.

Bechtel-Conyes, 220 Bush Street, San Francisco, California, has completed the laying of 62 miles of 18-in. pipe for The Texas-Empire Pipe Line Company between Wilmington and Gibson City, Illinois. This is a crude oil line.

Eastern Construction Company, 1801 Mercantile Bank Building, Dallas, Texas, is laying several loops for the Northern Natural Gas Company. The 9.11-mile loop in Kansas has been completed and field headquarters moved from Washington, Kansas, to Weeping Water, Nebraska. At the latter point a 29.5-mile loop is being constructed. Yet to be laid are 17.8 miles of 24-in. north of Oakland, Iowa, and 21.14 miles of 20-in. north of Palmyra, Nebraska. J. W. Arthur is general superintendent. Fred Ponder is spread foreman, having succeeded E. A. Black, and Fred Harwell is office manager.

J. O. "Red" Willett, Monroe, Louisiana (Stringing Contractor), is stringing pipe for Wunderlich and Griffis Pipe Construction Company on the Transcontinental Gas Pipe Line Corporation job. This is approximately 110 miles of 30-in. beginning at Highway 42 in Mississippi and extending to the Tombigbee River in Alabama. For Transcontinental he is also unloading and racking 425 miles of 30-in. between Eunice, Louisiana, and Danville, Georgia. For Associated Pipe Line Contractors, Inc., 122 miles of 26-in. is being strung between Lebanon and Lancaster, Ohio, on the Texas Eastern Transmission Corporation job. For Latex Construction Company on the Texas Gas Transmission Corporation job 101 miles of 26-in. is being strung between Sharon, Louisiana, and the Mississippi River at a point south of Lake Village, Arkansas.

J. R. Horrigan Construction Company, Commerce Building, Houston, Texas, is making steady progress on the Michigan-Wisconsin Pipe Line Company system from Hugoton gas field to points in Michigan and Wisconsin. At present construction is on 340 miles of 24-in. and 260 miles of 22-in. from Nordaway County, Missouri, to Mecosta County, Michigan. Ben Law is general superintendent. Spreads are working out of three field offices. J. F. Flannagan is superintendent at Grant City, Missouri; Louis Visentine at Mt. Pleasant, Iowa, and M. E. Shifflet at Burlington, Wisconsin.

The contractor also is laying 110 miles of 26-in. for Texas Gas Transmission Corporation from Memphis, Tennessee, northeast. Field headquarters are at Memphis. S. Law is superintendent.

R. H. Fulton and Company, P. O. Box 1542, Lubbock, Texas, is laying 130 miles of 26-in. gas line in Kansas for the Cities Service Gas Company. The 114 miles of 26-in. loops in Kansas for Panhandle Eastern Pipe Line Company has been completed except for some cleanup work. (June 21.) Also for Panhandle Eastern, 74½ miles of 24 and 26-in. loops is being laid in Kansas, and a crossing made of the Cimarron River. In Tennessee, 172 miles of 22-in. is being laid for the East Tennessee Gas Company. This is a joint venture with Oman-Fulton and Brodie.

Lee Holland Construction Company, P. O. Box 315, Magnolia, Arkansas, has recently completed laying 40 miles of 6 and 8-in. pipe line from Jackson, Louisiana, to the Louisiana State Penitentiary at Angola. Twenty miles was laid in the Tunica Hills, the remainder in the penitentiary grounds.

Associated Pipe Line Contractors, Inc., 4001 Homestead Road, Houston, Texas, had completed 28 miles through June 21 of the 122 miles of 26-in. being laid for Texas Eastern Transmission Corporation from Somerset to Lebanon, Ohio. J. A. Williamson is general superintendent, L. H. Gray spread foreman, and A. B. Johnson office manager.

Ray L. Smith and Son, Inc., Box 391, El Dorado, Kansas, had completed approximately 7½ miles of pipe to June 22 on the work being done for Atlantic Seaboard Corporation. The contractor is laying 65 miles of 26-in. from Clendenin, West Virginia, northeast to a point near Alexander, West Virginia. Joe L. Work is general superintendent, W. G. Frost spread superintendent, and J. H. Salisbury office manager.

Lewie Montgomery Trucking Company (Stringing Contractors), 1508 South Grant, Odessa, Texas, is stringing 63 miles of 12, 14, and 16-in. pipe from the San Salvador gas field to Brownsville, Texas, for the H. B. Zackery Company. The field office is at Harlingen with J. M. "Buck" Beavers the superintendent.

Dunn Brothers, (Stringing Contractors) 1420½ Wood Street, Dallas, Texas, are stringing 180 miles of 30-in. pipe for Morrison Construction Company on the Transcontinental Gas Pipe Line Corporation system. About 10 per cent of the pipe had been strung to July 1. John Samuel is superintendent in charge, working out of Columbia, Mississippi. The company also is stringing the pipe for H. C. Price Company, 200 miles, on the Atlantic Seaboard Corporation and Virginia Gas Transmission Corporation 26-in. line from Clendenin, West Virginia, to Rockville, Maryland. The job is about 25 per cent completed (July 1). H. G. Taylor is superintendent, working out of Petersburg, West Virginia. Late in June the company began stringing 30-in. pipe out of Fabens, Texas, and Jal, New Mexico, for the El Paso Natural Gas Company. This is on loops being laid by El Paso. L. L. Rowland is superintendent at Fabens and B. F. Carter at Jal. Work has recently begun also on 80 miles of 10-in. between Selmer, Tennessee, and Mussel Shoals, Alabama, for Lehman-Hodge & Scott, Contractors. Clifton Hammett is superintendent with headquarters at Selmer. Approximately 50 per cent of the pipe has been strung on the 80 miles of 30-in. near Spring, Texas, on the Tennessee Gas Transmission Company loops. The contractor is Morrison Construction Company. Elvin Chambers is superintendent with headquarters at Victoria.

Latex Construction Company, 2707 Ferndale Place, Houston, Texas, summarizes its construction work as follows:

For Texas Gas Transmission Corporation, 101 miles of 26-in. gas line from Sharon, Louisiana, northeast to the Mississippi River south of Lake Village, Arkansas. W. H. Hayes is superintendent, M. L. Thompson assistant superintendent, A. E. Stremmel office manager. Began laying pipe June 13. Present headquarters are at Farmersville, Louisiana.

For Shell Pipe Line Corporation near Eunice, New Mexico, 41 miles 14-in. crude oil line. E. C. Norris is general superintendent, R. E. Thornton superintendent, Ralph Axsom, office manager. This job is about half completed. Present headquarters are at Eunice, New Mexico.

For the Texas Pipe Line Company near Jacksboro, Texas, 36 miles of 8-in. crude oil line. H. L. Leake is superintendent, Sam B. Harrison office manager. This job got started about June 20. Present headquarters are at Jacksboro, Texas.

Construction of four pipe line pump stations for The Texas Pipe Line Company at Lindsay, Oklahoma, Haskell, Texas, Colorado City, Texas, and Odessa, Texas, is going forward. J. B. Latham is superintendent, W. E. Bayles office manager. Work well under way at the first three locations. General headquarters are at Wichita Falls, Texas.

For Interstate Natural Gas Company west of Baton Rouge, Louisiana, 29 miles of 16, 20, and 22-in. gas line. Job started early in July. F. A. Silar is general superintendent.

Vaughn and Taylor Construction Company, P. O. Box 1351, Wichita Falls, Texas, has completed the construction of a 177-mile gathering system for Phillips Petroleum Company in the vicinity of that company's Hansford, Texas, station. Size of the pipe varied from 3 to 24 in. D. D. Vaughn was superintendent in charge and W. W. Teer was office manager.

R. B. Potashnick, Cape Girardeau, Missouri, is now engaged in looping the Mississippi River Fuel Corporation's line between Perryville, Louisiana, and Fredericktown, Missouri. Approximately 218 miles of 24-in. pipe will be laid. W. C. Allred is superintendent in charge of the work.

Williams - Austin Company, Grant Building, Pittburgh, Pennsylvania, is constructing a 47-mile, 14-in. line for the New York State Natural Gas Corporation between Somerset and Johnstown, Pennsylvania. The job was 30 per cent completed June 25. Ralph Gaddy is superintendent, Ernie Mays timekeeper, Jeff Hill right-of-way foreman, P. A. Kennedy ditch foreman, and Rex Milburn welding foreman. A second spread has just completed laying 47 miles of 16-in. pipe for the same company from Smethport, Pennsylvania, to the New York state line near Genesee, Pennsylvania. Howard Bauer was superintendent, L. A. Franks timekeeper, O. L. King right-of-way foreman, L. O. Kennedy ditch foreman, and Arley Peacher lowering-in foreman. G. A. Manuel is president of the contracting firm and Ed Peters general superintendent.

Evans - James Construction Company, P. O. Box 546, Kerrville, Texas, had completed 165 miles of the Atlantic Pipe Line Company 10-in. being laid from Crane to Refugio, Texas, June 25. The total depth of the line will be 380 miles. J. B. Puckett is the superintendent. This is a joint venture of S. E. Evans Construction Company of Ft. Smith, Arkansas, and the Worth & James Construction Company of Little Rock.

O. C. Whitaker, 804 Dan Waggoner Building, Fort Worth, Texas, is now engaged on two major jobs. One is 90 miles of 20-in. for United Gas Pipe Line Company from the Baxterville field, Mississippi, to a point near Mobile, Alabama, and 9.5 miles of gathering lines in the Baxterville field. The gathering lines have been completed, but the main line pipe has been delayed and thus far only right-of-way work has been done. Jimmy Reid is general superintendent. Two field offices have been opened, at Lumberton and Lucedale, Mississippi. Pat Rogan is office manager at Lumberton and Earl Nevins at Lucedale. The other job is 90 miles of 26-in. for Texas Gas Transmission Corporation from Greenville to Lula, Mississippi. Approximately 16 miles had been laid to July 1. Barney Hall is superintendent and Lee Price manager of the field office at Cleveland, Mississippi.

Oklahoma Contracting Company, 1210 Mercantile Bank Building, Dallas, Texas, had completed approximately 95 miles on the Michigan-Wisconsin Pipe Line Company job to July 1. The section under construction is from Big Rapids, Michigan, to a point near Crown Point, Indiana, a distance of 180 miles. The pipe is 22-in. The field office has been moved from Rockford to Allegon, Michigan. H. A. Wylie is general superintendent, Robert Hall office manager, and C. W. Goodwin welding foreman.

Approximately 35 miles of the 102 miles of 26-in. being laid for Texas Gas Transmission Corporation had been completed. This section extends from Fulton to Providence, Kentucky. The field office is at Mayfield. L. B. Rea is superintendent, Dick Mueller office manager, and H. A. Rowden welding foreman.

Sparling-Davis Company, Ltd., 7310-99th Street, Edmonton, Alberta, Canada, is laying 47 miles of gas gathering lines in the Devon Alta area for Imperial Oil, Ltd. The pipe is of 3, 4, 5, and 6-in. diam. The job was 30 per cent completed June 25. In the Redwater Alta area 12 miles of 5-in. is being laid for the B. A. Alta Pipe Line Company.

Midwestern Constructors, Inc., 105 North Boulder Street, Tulsa, Oklahoma, has been laying pipe since June 1 on sections 4 and 5 of the Transcontinental Gas Pipe Line Corporation system. These two sections comprise 216 miles of 30-in. from Demopolis, Alabama, to Newman, Georgia. The field office is at Demopolis and M. T. "Bill" Wilhite is superintendent. Because of late pipe deliveries construction was delayed on Spread 10 of the Texas Gas Transmission Corporation line, 80 miles of 26-in. from Jefferson County, Indiana, to Warren County, Ohio. Work on the Ozark Pipe Line System for Shell was completed June 1. Pump station work on the Ozark System, consists of installing units and piping facilities, is at the following places: Cushing, Oklahoma, E. S. Powell superintendent; Chelsea, Oklahoma, Lyle S. DeWitt superintendent; Diamond, Missouri, E. P. Anderson superintendent; Buffalo, Missouri, F. E. Everett, Jr., superintendent, and Bland, Missouri, Ralph Bray superintendent. A part of this work has been completed. Additions are being made to the compressor station and dehydration plant at Fritch, Texas, for Texoma Natural Gas Company. J. A. Bard is superintendent in charge of construction.

H. C. Price Company, Union National Bank Building, Bartlesville, Oklahoma, has completed construction of 60 miles of 18-in. oil pipe line between Gibson and Bethany, Illinois, for The Texas-Empire Pipe Line Company. One spread, under the supervision of R. K. Shivel, averaged two miles a day to complete the pipe line well ahead of schedule. Key men on the project in addition to Shivel were: Ray Stokes, office manager; J. D. White, right-of-way; Blondie Olrich, ditch; J. H. Latham, bend; C. E. Shivel, pipe; Bob Ezell, weld; U. M. Beaver, dope; G. E. Beaver, lower-in; Ray Drewell, crossings, and Sam Price, cleanup. The field construction office was at Champaign, Illinois, during the entire project.

Equipment was then moved to Rockville, Maryland, where the spread began construction on a 68-mile section of 26-in. high pressure gas pipe line and will install ten major river crossings across the Shenandoah and Potomac Rivers for the Atlantic Seaboard Corporation and Virginia Gas Transmission Corporation.

Two additional Price spreads are constructing 122 miles of pipe line, working toward Strasburg, Virginia, Shivel's completion point. These two sections of the line are under the supervision of W. B. Williams with field office at Elkins, West Virginia, and Charlie Ice with headquarters in Petersburg, West Virginia.

Wunderlich & Griffis Pipe Construction Company, 745 Riverside Drive, Tulsa, Oklahoma, "kicked off" about the middle of June on its section of the Transcontinental Gas Pipe Line Corporation. This contractor is handling Schedule No. 3, which begins at Highway 42 in Mississippi and extends to the Tombigbee River in Alabama, a distance of approximately 110 miles. The field office is at Laurel, Mississippi, and C. W. Broome is the superintendent. For Northern Natural Gas Company, 57 miles of loops are being laid, 22.09 miles north of Ogden, 26.47 miles north of Ventura, and 9.11 miles north of Clifton. All is 24-in. pipe.

Mahoney Contracting Company, Mt. Pleasant, Michigan, began a new job July 1 for Ohio Fuel Gas Company, 27 miles of 20-in. and 15 miles of 16-in. between Sugar Grove and Westerville, Ohio. Another job for the same company, 20 miles of 20-in. between Republic and Perrysburg, was recently completed. Harold Finnerty is general superintendent of the new job. Henry Mogg spread foreman, and Don McDonell office manager.

TGT Accepts Underwriting Group Bid on Bonds

The Tennessee Gas Transmission Company has accepted the bid of an underwriting group headed by Stone Webster Securities Corporation and White, Weld and Company for the purchase of $50,000,000 first mortgage pipe line bonds due in 1969, it was announced by Gardiner Symonds, company president. The successful bidders offered 100.3399 for a coupon of 3 per cent. This was the first time that the Tennessee Gas Transmission Company has had open competitive bidding on its bonds and was done to comply with an order issued by the Federal Power Commission last December.

The Stone Webster Securities Corporation and White, Weld and Company group will re-offer the bonds for sale to the public as soon as practical after the post effective amendment to the registration statement filed with the Securities and Exchange Commission becomes effective. The price on the public offering will be 100¾ to yield 2.95 per cent.

The company will use the proceeds from the sale of the bonds, along with other cash resources, for the expansion of its natural gas pipe line system, Symonds said. The system now has a daily delivery capacity of approximately 615,000,000 cu ft. The company is presently engaged in a program to increase the daily capacity to 831,000,000 cu ft pursuant to certificates of public convenience and necessity issued by the Federal Power Commission.

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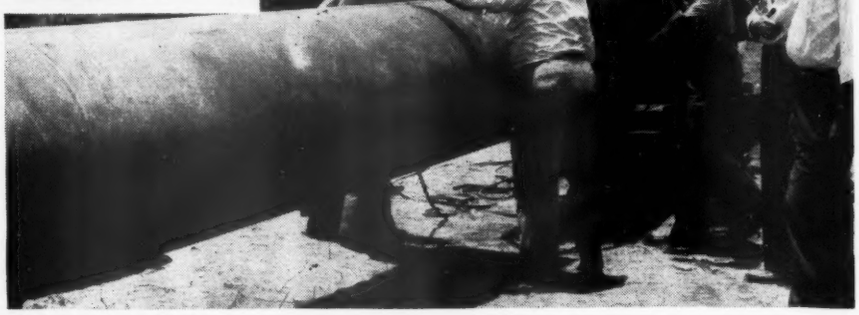
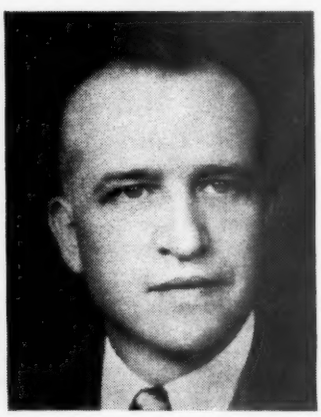
Transportation

Some company and contracting officials constructing Transcontinental Pipe Line.



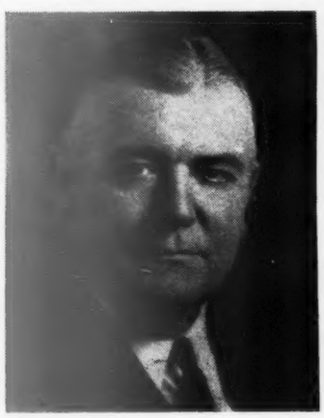
At ceremonies marking the start of the Transcontinental Gas Pipe Line Corporation project. (See article this issue). R. D. Ricketts (left), vice president of Fish Constructors, Inc., agent for Transcontinental, and Mrs. Ricketts; Mrs. Williams; Claude A. Williams, president, Transcontinental; Mrs. Fish; Ray Fish, president, Fish Constructors.



Lining up pipe for the first weld. Directing operations is G. G. Griffis of Wunderlich & Griffis Construction Company.

Schedules 4 and 5, in Alabama and Georgia, are being laid by Midwestern Constructors, Inc. F. E. Stanley (left), president; C. C. Bledsoe, secretary-treasurer and M. T. Wilhite, general superintendent.

Williams Brothers Corporation will lay Schedule 6 in Georgia for Transcontinental. Below are S. M. Williams, Jr. (left), president; G. S. Connors, vice president; David R. Williams, vice president, and C. A. Stanfield, vice president and treasurer.



Pictorial

A group of officials of Shell Oil Company who participated in the construction of the Ozark Pipe Line System. (See article this issue).

W. H. Shelley, general superintendent of Ozark construction, is West Texas area superintendent.

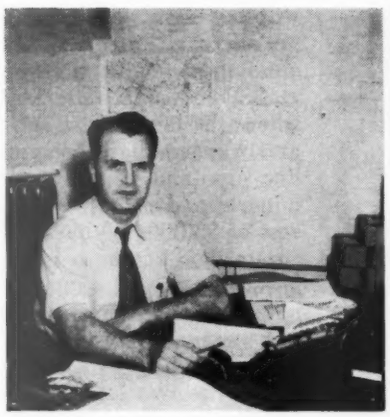
C. D. Winkelman, far left, assistant general superintendent of construction, is Mid-Continent area superintendent.

Terry O'Neill, right-of-way representative from Houston, and John Reese, assistant to the general superintendent, who was safety engineer in the West Texas area.

H. H. List, Mid-Continent area engineer, and Don Akers, draftsman.

C. B. Shell, chief clerk, from treasury-accounting, Houston.

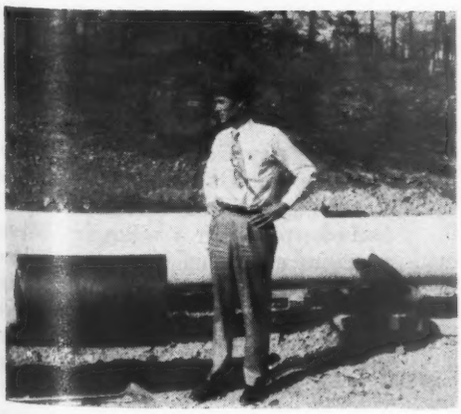
J. V. Dickey, assistant material man, was from Cushing, Oklahoma.

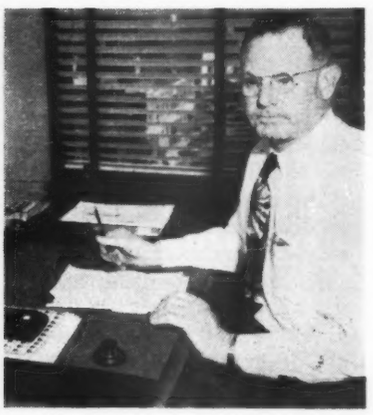


R. F. "Bill" Sayers, assistant chief clerk, also from Cushing.

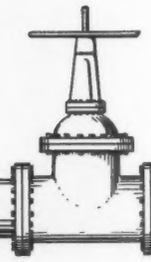
Cecil W. Galbraith, project buyer, from purchasing-stores, Houston.

W. B. Sanders, Missouri division superintendent.





PIPE LINE PROJECTS



Edmonton-Regina Oil Line Being Surveyed

Ground survey and other work on the 450-mile Edmonton- Regina crude oil line is proceeding as rapidly as possible, Dr. O. B. Hopkins, newly appointed president of the Interprovincial Pipe Line Company, Ltd., states. Authority of the board of transport commissioners to construct the line has been given.

Air mosaics have been taken and studied to determine the best route, Dr. Hopkins said. The line will take a fairly direct course avoiding lakes, towns, and other obstacles. Ground survey parties will work at several points along the line for greater speed.

"The primary objective of the line is to help obtain a wider market for Alberta crude as soon as possible," Dr. Hopkins said. "This objective can only be attained by keeping transportation cost to a minimum and this in turn can only be done by construction of a pipe line along the most direct route possible in the direction of ultimate markets.

"Completion of the line to Regina will not expand the present market for Alberta crude as the prairie area is already saturated and crude is moving beyond Regina by tank car.

"Imperial considers the Edmonton-Regina line a 'first step' toward wider markets and is now studying extension of the line from Regina to the Great Lakes."

Before this year no Dominion legislation governing interprovincial pipe lines existed, but at the last session of the Canadian Parliament a federal Pipe Lines Act and a special act incorporating the Interprovincial Pipe Line Company were passed. This legislation gives the company authority to build interprovincial oil pipe lines. The right is subject to approval of the board of transport commissioners. The decision of the transport board sanctions the first Canadian pipe line under the new Dominion legislation.

Originally announced as a 16-in. line, consideration is now being given to making it a 20-in. line. The 16-in. line would carry from 100,000 to 125,000 bbl a day and the 20-in. from 150,000 to 175,000 bbl. Although 16-in. pipe already has been ordered, if it is decided to go to the larger size the 16-in. could be used on the extension from Regina eastward, it is pointed out.

Officers of the Interprovincial Pipe Line Company in addition to Dr. Hopkins, are: Vice president and director, F. G. Hall; secretary, R. D. Murray; treasurer, K. A. Henderson; directors, A. E. Halverson, J. R. White, C. D. Crichton, and R. B. Burgess. All are officials of Imperial Oil, which is sponsoring the Interprovincial Pipe Line Company. The new company has an authorized capital of $200,000,000.

New Orleans-Chicago Gas Line Proposed

First official announcement has been made of a proposed gas pipe line to extend from New Orleans, Louisiana, to Chicago. The announcement was made by the law firm of Chill, Landman and Gordon of Washington, D. C., and Jackson, Mississippi, acting in behalf of its principals, American Gas Transit Corporation, Ltd. The line will be 30-in. in diameter and will operate at a pressure of 1000 psi, it is announced. The total cost is estimated at $300,000,000. The principles for whom the law firm is acting say that arrangements have been made for the line pipe and market outlet and that mineral and royalty purchases in excess of $3,000,000 have been made in coastal and southern Louisiana.

A. M. Crowell, natural gas consultant of New Orleans and Shreveport, was engaged to study natural gas reserves and has been retained to assist in the negotiation of gas purchase agreements. The goal is the purchase of 6 trillion cu ft of natural gas.

Short Line Authorized

The Federal Power Commission has authorized Mountain Fuel Supply Company, of Salt Lake City, Utah, to construct a $1,750,000 pipe line project designed to increase the company's deliveries of natural gas in the Salt Lake Valley of Utah by approximately 23,600,000 cu ft per day.

The newly-authorized 32-mile, 20-in. pipe line, which will parallel an existing 16-in. line operated by the company, will extend from Coalsville, Utah, to Salt Lake City. Present capacity of Mountain Fuel's system is approximately 111,000,000 cu ft per day.

FPC Won't Reopen Atomic Energy Case

The Federal Power Commission has denied one request for reopening, and another for rehearing, in the proceedings in which FPC recently authorized East Tennessee Natural Gas Company to build pipe line facilities to supply 60,000,000 cu ft of natural gas a day to the Atomic Energy Commission's plant at Oak Ridge, Tennessee.

The two requests were filed jointly by the National Coal Association, Railway Labor Executives Association and United Mine Workers of America, all interveners in the Oak Ridge proceedings.

The first joint application, filed with FPC June 2, asked for rehearing, reconsideration, revocation, and abrogation of the commission's findings and order of May 3 authorizing construction of the Oak Ridge line. This application claimed, among other things, that FPC predicated its findings of public convenience and necessity "solely on the basis of the strong representations made by the Atomic Energy Commission."

The second request, filed June 13, asked the commission to reopen the proceedings for the purpose of considering, in connection with the June 2 application for rehearing, a report of a subcommittee of the Congressional Joint Committee on Atomic Energy on the Oak Ridge pipe line project.

Ask Authority for Wyoming-Montana Line

The Federal Power Commission has been asked to authorize construction of a proposed $8,419,880 pipe line project that would make available an additional 35,000,000 cu ft of natural gas a day to customers of Montana-Dakota Utilities Company in Montana and North and South Dakota.

A joint application filed with FPC by Montana-Dakota and Montana-Wyoming Gas Pipe Line Company includes plans for a 340-mile 12¾-in. pipe line extending from the Worland field in Washakie County, Wyoming, to Montana-Dakota's Cabin Creek compressor station in Fallon County, Montana; a combination gas compressor, dehydration and sulphur re-

moval plant near the Wyoming origin of the line; and two branch lines, one connecting with the present gas distribution system at Miles City, Montana, and the other connecting with a distribution system to be built by Montana-Dakota in Forsyth, Montana.

The 340-mile main line and combination plant would be constructed and owned by Montana-Wyoming and operated under lease by Montana-Dakota. The branch lines would be constructed, owned, and operated by Montana-Dakota.

Both Montana-Wyoming, a new corporation organized May 20, and Montana-Dakota have main offices in Minneapolis, Minnesota, and offices, as far as shown by the application, are the same.

Michigan-Wisconsin Asks For Additional Capacity

The Federal Power Commission has scheduled oral argument to be held July 20 in Washington, D. C., in the preceeding involving a joint application filed by Michigan-Wisconsin Pipe Line Company and Michigan Consolidated Gas Company for FPC authorization to construct, among others, additional natural gas facilities in connection with Michigan-Wisconsin's Texas-to-Michigan pipe line project, initially authorized by the commission in 1946.

The joint application involves a proposal to increase capacity of Michigan-Wisconsin's authorized 1050-mile line by approximately 28 billion cu ft of gas per year through installation of additional compressor units. The line as presently authorized by FPC would have a capacity of about 47 billion cu ft annually.

Hearing Scheduled on Gas Line Proposal

The Federal Power Commission has scheduled a hearing to begin July 20 in Washington, D. C., on the application of Kansas-Nebraska Natural Gas Company, Inc., for authorization to construct additional natural gas facilities that would increase the delivery capacity of the company's system to 140,000,000 cu ft of gas a day.

The company is proposing to construct 14 town border measuring stations and approximately 301 miles of main, lateral, and loop pipe lines, to install gas compressors with a total of 3600 hp in existing compressor stations, and to purchase 15 miles of service line and 30 dehydration plant service connections from Nebraska Natural Gas Company.

Kansas-Nebraska, which has main offices in Phillipsburg, Kansas, estimates the cost at $2,339,457.

Ohio Fuel Would Store More Gas Underground

The Ohio Fuel Gas Company, of Columbus, Ohio, has asked the Federal Power Commission to authorize facilities necessary for expansion of the company's underground natural gas storage capacity by approximately 16.6 billion cu ft. Estimated cost of the project is $1,090,975.

The company, a subsidiary of The Columbia Gas System, Inc., is proposing to convert six natural gas producing pools in north central and south central Ohio to underground storage service. The proposal also includes construction of about 59.8 miles of pipe line to be used in connection with storage operations, and retirement of approximately 53.1 miles of existing well and gathering lines.

The application says that because of declining production in local fields, it is necessary for the company to receive increased deliveries from out-of-state sources. In order to accept this gas in quantities necessary to meet winter demands, it is necessary to place large volumes in underground storage in summer for withdrawal in winter.

Central Ohio Gas Line Authorized

The Federal Power Commission has authorized Ohio Fuel Gas Company, a subsidiary of The Columbia Gas System, Inc., to construct approximately 85.5 miles of natural gas transmission pipe line in central Ohio to replace approximately 84.1 miles of line that the company was authorized to retire. Estimated cost of the project, after salvage of the facilities to be retired, is $3,239,720.

The company plans to use the newly authorized facilities to provide increased capacity for transportation of gas from out-of-state sources to underground storage areas in summer for withdrawal in winter. Ohio Fuel now has an application pending before the Commission for authorization to expand its storage facilities.

Bids Asked For Line

The Salt Lake Pipe Line Company has asked for bids on the first segment of a 560-mile products pipe line from Salt Lake City into the Pacific Northwest. The immediate project is to lay 320 miles between Salt Lake City and Boise, Idaho. Later the line will be extended north from Boise to a terminal in western Washington. Total cost of the line will be in excess of $12,000,000, according to C. E. Finney, Jr., president of the company.

1369
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*This figure does not include the mileage under contract at the end of 1948, to be completed during 1949, amounting to 181 miles.

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MARINE OPERATIONS

Largest Normal Tanker Launched in United Kingdom

The single screw motor tank vessel *C. J. Hambro* for Erling H. Samuelsen's Rederi A/S. Oslo, was successfully launched at the Haverton Hill Shipyard of the Furness Shipbuilding Company, Ltd. The vessel is the 112th tanker built at the Haverton Hill Shipyard, and apart from a larger combined tanker and whaling factory vessel already constructed by the builders will be the largest normal tanker yet launched in the U. K.

She is the first of a series of ten similar tank vessels on order with the Builders, and is of the poop, bridge, and forecastle type with machinery fitted aft, with a well raked stem and cruiser stern, and is constructed to Lloyds highest class, under their special survey, for carrying oil in bulk.

A deadweight of about 24,900 tons will be carried on Lloyds Summer Draught of 32 ft 3 in., the designed speed being 14 knots on trial.

Esso Cristobal Launched As Fifth New Supertanker

Recently christened as *Esso Cristobal*, the 26,500-dwt tanker for Standard Oil Company (New Jersey) has been launched at the Newport News Shipbuilding and Dry Dock Company following the floating of the *Esso Montevideo* by two months. The *Esso Cristobal* is the fifth of a new fleet of 14 and the third of 10 giant-sized vessels being built by the Newport News yard for the Esso fleet. With a volumetric capacity of 230,000 bbl of oil, the *Esso Cristobal* is 628 ft overall, has a molded beam of 82 ft 6 in.; molded depth of 42 ft 6 in. to the upper deck, and a draft of 31 ft 11 in. The new tanker has a design speed of 16 knots, and with the *Esso Montevideo* and *Esso Suez*, constitute the initial units of a "mile of tankers" that will go down the ways at Newport News and into the world-wide service of Standard Oil Company (New Jersey) this year.

The oil industry's need for tankers, which rose sharply in 1947, continued to be high through the early months of 1948 and this situation improved toward mid-year, and throughout the remainder of the year more than enough tankers were available to meet immediate requirements, states the annual report of Standard Oil Company (New Jersey). To provide lower-cost transportation when charter arrangements with outside interests expire, as well as to replace obsolete vessels, the company in 1948 placed contracts for the construction of 14 tankers of 26,500 dwt and a speed of 16 knots. Each of these vessels, which are part of the company's postwar super tanker program, will be 628 ft long and will have a cargo tank capacity of 230,000 bbl. They will carry the latest in equipment, including radar for safer navigation. Eight of these tankers are expected to be ready for service in 1949 and the balance during 1950.

Privately Owned Tankers

The privately-owned U. S. merchant fleet on May 1, 1949, totaled 1202 seagoing vessels of 1000 gross tons or over compared to 1209 such vessels on April 1, National Federation of American Shipping reported in its monthly summary of the status of the American Merchant Marine. The report showed there were 484 tankers of approximately 7,062,000 dwt.

Motor Tanker Launched

The Belfast yard of Harland and Wolff, Ltd. reports the launching of the motor tanker *Vestfoss* for Thor Thoresens Linje of Oslo, Norway. Principal dimensions of *Vestfoss* are: Length overall, 487 ft 6 in.; length b.p. 460 ft; breadth moulded 59 ft, depth moulded 34 ft 10 in. and deadweight about 12,000 tons on 27 ft 6 in. draft. The vessel has a cruiser stern, modern type semi-clipper stem rounded above waterline, stump fore mast, telescopic signal mast amidships and streamlined funnel. Constructed on the combined longitudinal and transverse system of framing there are two main longitudinal bulkheads with transverse bulkheads forming 24 main cargo oil tanks.

Tanker Converted to Carry Butane Gas

Completely scaled and converted to carry butane gas in bulk, the Dutch oil tanker *Frasca* has been delivered by the Grayson, Rollo and Clover Docks, Ltd., England. Conversion of the tanker involved extensive refitting and a large number of deck and ship side plates were renewed. The tank deck has been cut away and renewed, and new independent butane tanks fitted inside the main cargo tanks.

The butane cargo necessitated, apart from the independent tanks, installation of a complete new piping and pumping system, the vessel's previous system still being in use, as other oil will be carried in the tanks independent of the butane. All the accommodation has been modernized and completely rebuilt to the latest standards, while the centre castle and bridge have been renewed and new deckhouses built on the after accommodation. The engine and boilers were completely overhauled and new tailshafts have been fitted.

Restricts Movement of Craft Contacting Tankers

Authorities for the Suez Canal Company have announced that effective August 1, no private craft of any description except the agent's launch will be allowed to proceed alongside or make fast to tankers loaded with benzine or crude oil during their passage through Port Said harbor. This will mean that such vessels will be obliged to take their supplies of provisions and fresh water at Suez. Any stores or spare parts sent out for such tankers should therefore be sent to Suez for delivery.

At the same time, circular No. 185/PC35, was issued by the Canal company advising that the prescriptions of Article 21 of the Appendix to the Rules of Navigation for ships carrying dangerous cargo, relating to notice of arrival, applies to non "gas free" benzine tankers and non "gas free" petroleum tankers. Already complied with in practice, the regulation will be strictly enforced in the future, it is asserted.

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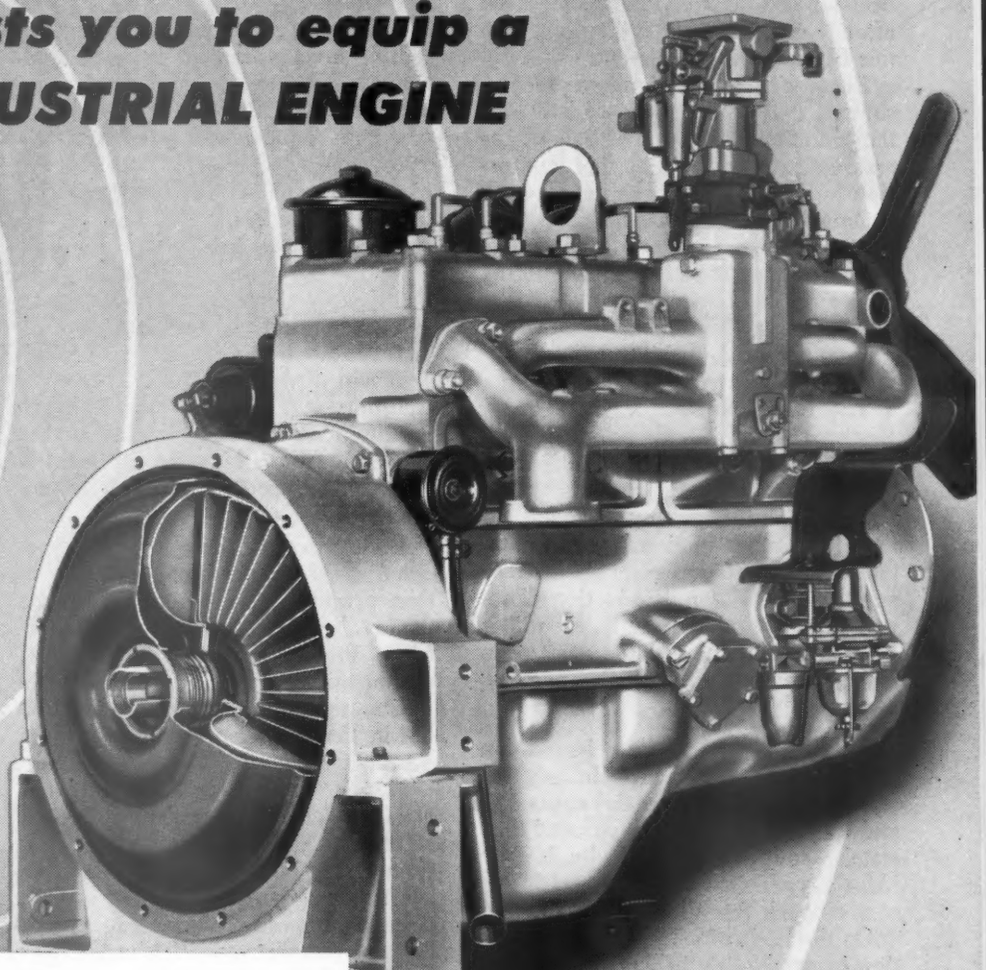

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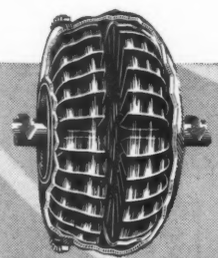

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NEWS

FPC Loses Fight for Control

The Supreme Court has ruled that the Federal Power Commission has no control over the way a natural gas company disposes of its reserves. The decision was delivered by Justice Reed after the high court's 5-3 ruling. Justice Black wrote the dissent.

Reed stated that congress clearly showed that it did not intend to give the commission power over sale of gas reserves. He added that the commission for 10 years never had made such a claim of authority, and failure to use such a power for so long a time indicates that it did not believe the power existed. Reed also stated that the Supreme Court should not push powers granted over transportation and rates so as to include production.

The case involved the Panhandle Eastern Pipe Line Company, which owns a natural gas pipe line system originating in Texas, Oklahoma, and Kansas. The company decided to transfer gas production leases on 96,000 acres for its gas reserves in Kansas to the Hugoton Production Company, a Panhandle affiliate, which later contracted to sell the gas to the Kansas Power and Light Company.

Oil Allowables Cut

Emergency orders were issued for oil production cutbacks in several states last month. The Arkansas Oil and Gas Commission has reduced that state's crude oil allowable by 10,000 bbl daily. This represents a 15 per cent cutback for all controlled pools.

On the heels of a 15 per cent reduction in production in Arkansas, came a 15 per cent reduction in daily crude oil purchases in Arkansas, Louisiana, and Mississippi by Esso Standard Oil Company, largest buyer in the area.

Texas also is sustaining severe cutbacks. Crude producers in Texas were handed their seventh consecutive allowable reduction last month. Effective July 1, the oil quota was 1,871,938 bbl daily, a cutback of 125,101 bbl daily against the permissive on June 11. In Oklahoma the June crude oil allowable was set at 380,776 bbl daily, a reduction of 37,511 bbl from April production.

The decreased rate of production of crude oil in the United States resulted in another slight decline in total world output in April. The Middle East, Venezuela, and most other foreign producing areas showed increases.

Announces Opening

Max W. Ball, oil and gas consultant, has announced the opening of his new office. It will be situated in Washington 5, D. C.

Business Prospects Good Speakers Tell Oil Men

Business prospects for the Pennsylvania Grade crude oil industry are bright, speakers agreed at the Pennsylvania Grade Crude Oil Association's 26th annual meeting in Oil City, Pennsylvania.

Lubricant requirements for automotive and industrial use will continue to expand, D. M. Hobart, manager of Curtis Publishing Company's research department, predicted. By 1953, he said, 50,000,000 vehicles are expected to be on the road, up 21.5 per cent over 1948. He listed as factors in greater prospective oil consumption the many older cars now on the highways and the expanding markets in aviation and farming.

J. M. Koch of Oil City, vice president and director of Quaker State Oil Refining, stated that motor oil quality and performance depend on the crude oil from which the lubricant is derived and, secondly, on the skill employed in refining.

D. T. Ring of Columbus, Ohio, presided at the annual dinner as association president. He told the Pennsylvania oil producers, refiners, and marketers that reduced Pennsylvania oil output still exceeds refinery requirements, pointing to a gain of 468,000 bbl in Penn Grade crude stocks from a year ago.

James V. Brown, Washington, D. C., National Petroleum Council secretary-treasurer, regarded as a serious factor in the oil picture the British program proposing an increase in Britain's domestic refining capacity of 800 per cent between 1947 and 1953. Whether imports of foreign oil are supplementing or supplanting domestic production is a problem awaiting a study being mapped by the Secretary of the Interior, Brown declared.

Indians Sue Oil Companies

Fifteen oil companies have been sued in the U. S. District Court by six members of the Osage Indian Tribe. The Indians asked for $11,000,000 damages from the companies, and asked also that oil leases in the Osage Nation's North Burbank field be cancelled.

The petition asserted that the Osage Tribe is entitled to $8,000,000 because of the defendant oil companies' failure to "diligently develop and operate" leases on 18,000 acres of oil land.

Move Offices

Texas Mid-Continent Oil and Gas Association announces the removal of its offices to 1800 M & W Tower Bldg., Dallas 1, Texas.

Millard K. Neptune

Forms Foreign Department

Establishment of a foreign department by Continental Oil Company and the appointment of Millard K. Neptune as manager was announced by L. F. McCollum, president.

Continental has long been active in Canada through its affiliate, Hudson's Bay Oil and Gas Company, Ltd. Early this year Continental joined with Amerada Petroleum Corporation and the Ohio Oil Company to form Conorada Petroleum Corporation to search abroad, elsewhere than in Canada, for prospects considered to be favorable for oil and to negotiate for acquisition of operating rights on such prospects for the parent companies. Headquarters for the new foreign department are to be established in New York City.

Legal Aspects Considered

The junior section of the Pacific Petroleum Chapter, AIME, met to discuss the legal aspects of gas and oil leases. In the absence of Charlie McClure, Norman Clark presided.

The speaker of the evening, Verne Robinson, is a graduate of the University of Montana, and veteran of the first World War.

He opened his talk with a description of the primary constituents of an oil and gas lease, and gave some interesting information on late court decisions affecting holdout lessors in community leases. He also discussed the surface and subsurface rights of both the lessor and lessee; the inclusion of clauses allowing the lessee to inject water or gas as a secondary recovery medium. Many cases involving controversy over oil and gas leases were cited, and it was particularly emphasized that the greatest care should be exercised in defining "paying quantities;" drilling depth requirements; multiple zone development; and offset obligations.

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20 .42 .70 .054 .09 .19 .29
25 .56 .94 .072 .12 .25 .38
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2.82 4.70 .360 .60 1.08 1.62
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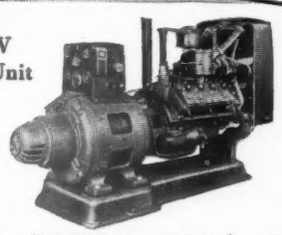
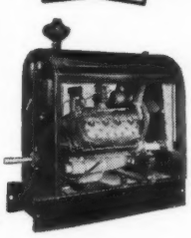
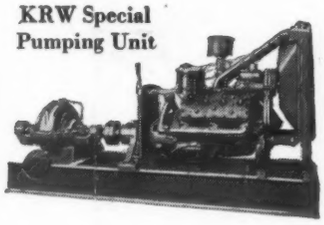




KRW Special Pumping Unit



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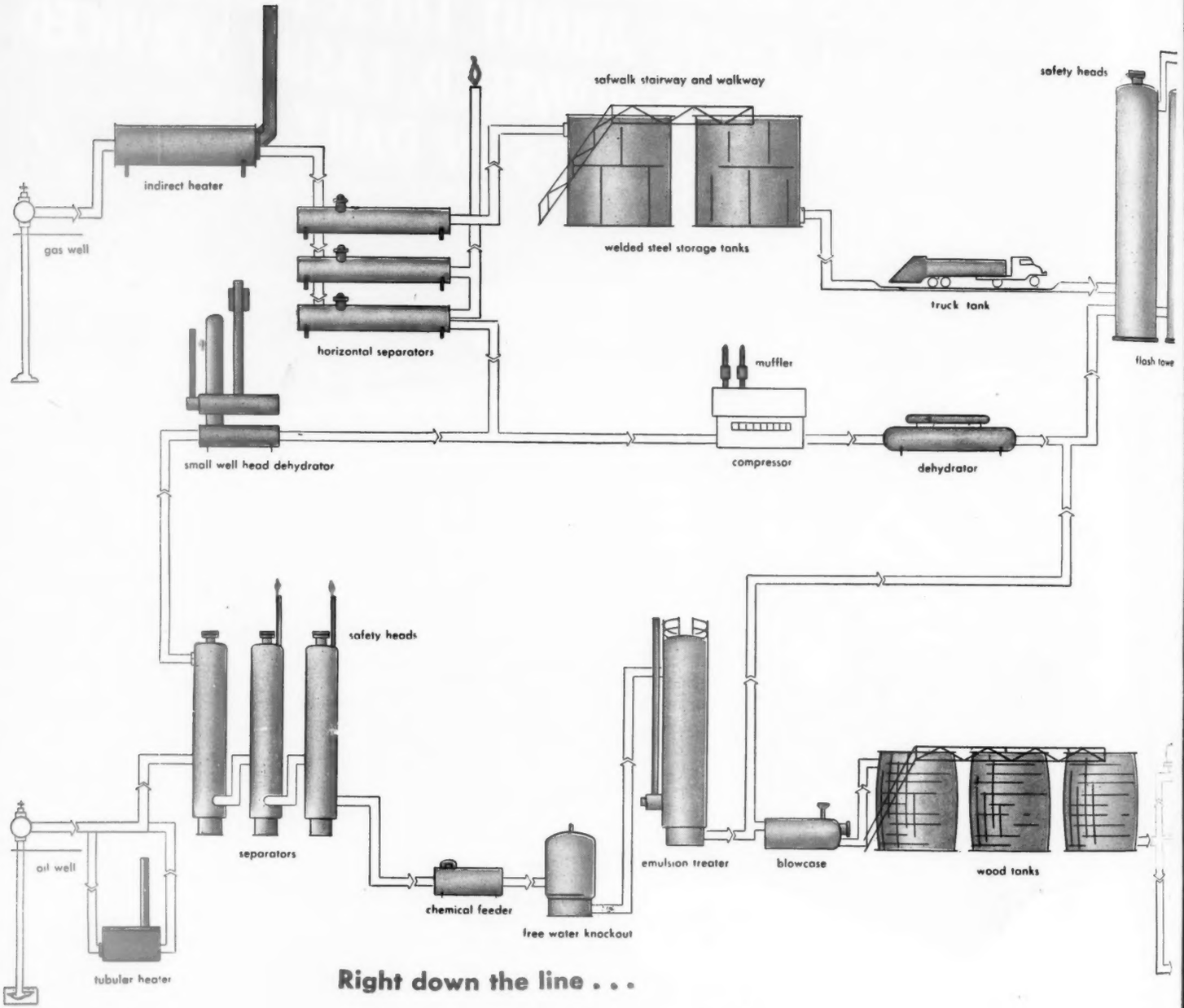

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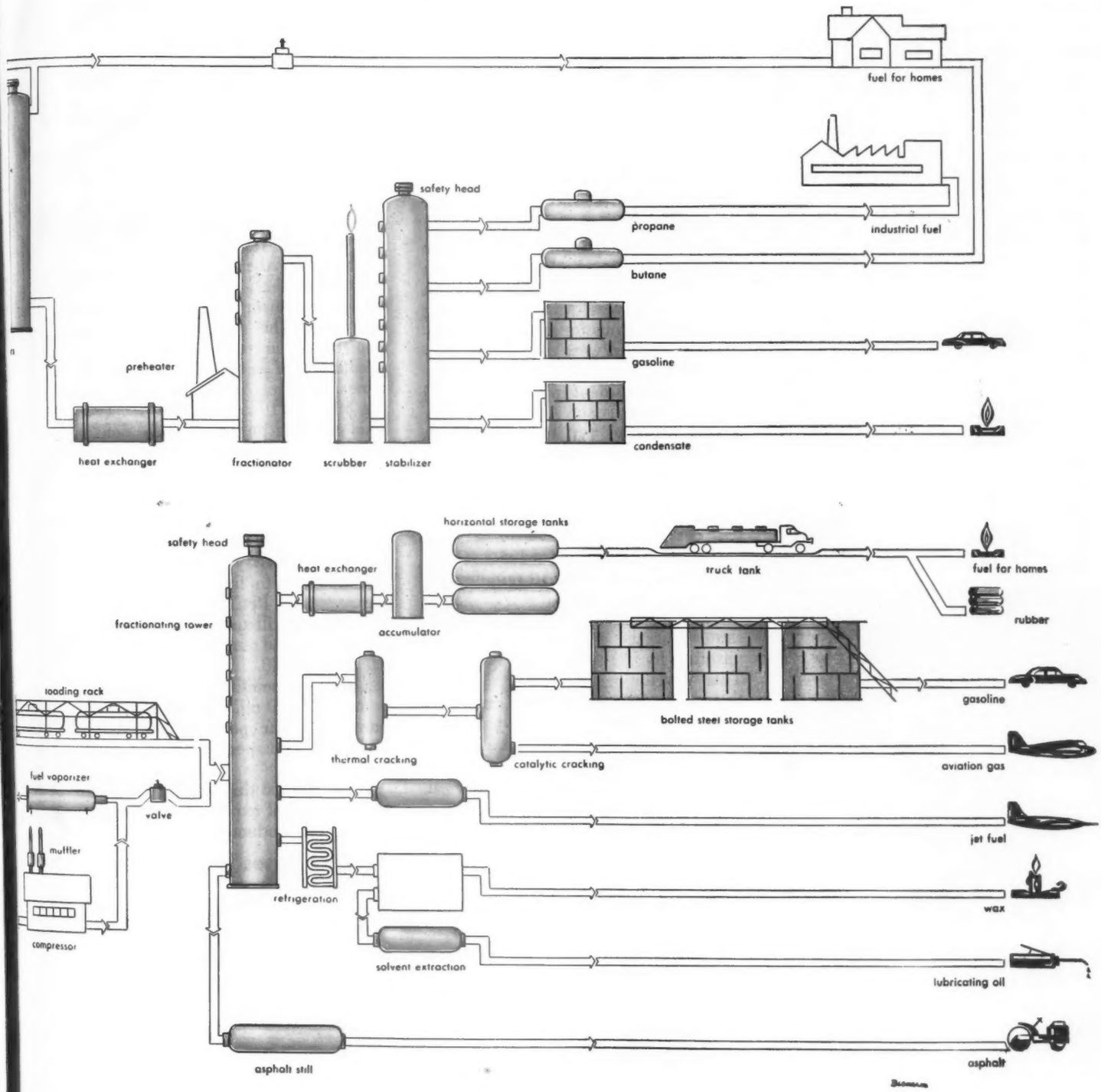
fuel for homes
safety head
propane
industrial fuel
butane
gasoline
preheater
condensate
heat exchanger
fractionator
scrubber
stabilizer
horizontal storage tanks
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truck tank
fuel for homes
heat exchanger
rubber
accumulator
fractionating tower
loading rack
gasoline
bolted steel storage tanks
thermal cracking
catalytic cracking
aviation gas
fuel vaporizer
valve
jet fuel
muffler
refrigeration
wax
compressor
solvent extraction
lubricating oil
asphalt still
asphalt

NEWS

Oil Tax Upheld

The Supreme Court has ruled that Mississippi is within its rights in charging a 2 per cent sales tax on oil gathered in the state, but shipped to other states. The Interstate Oil Pipe Line Company appealed to the Mississippi courts and then to the high court, in attempting to get a refund on $20,296.36 collected from them by the state of Mississippi.

The company attacked the tax as an unconstitutional levy on interstate commerce, but the Court ruled that it did not matter whether the company's operations were interstate. Since all the activities upon which the tax is imposed are carried on in Mississippi, there is no due process objection to the tax. Interstate contended that operation of pipe lines was interstate commerce and could not be constitutionally taxed.

The opinion stated, "the tax does not discriminate against interstate commerce in favor of competing intrastate commerce of like character. There is no attempt to tax interstate activity carried on outside Mississippi's borders, and therefore the commerce clause does not invalidate this tax."

BETTER PIPE TOOLS

"ARMSTRONG BROS." Pipe Dies and Chasers are machined from special alloy steel, are heat treated and oil tempered. Cutting teeth are "backed-off" with ground points—cut faster, cut easier, cut smooth, tight-fitting threads. They come in "Solid," "Adjustable" and "Receding" types to fit all standard make stocks and threaders. Standardize on "ARMSTRONG BROS." Dies and Chasers for better thread cutting.

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Orders Refunds

Four major oil companies have been ordered by a Cairo court to refund a total of 800,000 Egyptian pounds ($3,328,000) to the Egyptian government. They are Shell Oil, Socony-Vacuum, Societe Egyptienne des Petroles and Societe du Napthe. The sum represents wartime price increases authorized by the government to cover any war damage the companies might sustain. No damage occurred.

A spokesman said the companies would appeal the decision.

Standard Celebrates Sixtieth Anniversary

Standard Oil Company (Indiana) celebrated its 60th birthday on June 18, 1949. To mark the occasion the company presented souvenir fountain pens to employees. Anniversary issues of its publications for employees, dealers, and agents, were distributed, special letters from the chairman of the board and president to employees and dealers were sent. An anniversary leaflet was also sent to stockholders.

Standard Oil Company (Indiana) was incorporated in 1889. Its first act was to build a refinery at Whiting, Indiana. With the coming of the "horseless carriage" the oil business grew rapidly. By 1910 Standard was selling petroleum products in 10 middlewestern states. About 1912 it started building service stations, and at about the same year the process of obtaining gasoline by cracking was developed. This development greatly increased the yield of gasoline from crude oil and enabled refiners to keep pace with the rapidly increasing demand for inexpensive motor fuel.

Today the Whiting plant and four other refineries, built later, make gasoline, motor oil, kerosine, and altogether 2000 products from petroleum for distribution under the company's own name.

"Originally a subsidiary of a nationwide Standard Oil organization, our company became entirely independent, separate, and distinct in 1911 and has so operated ever since," Dr. Robert E. Wilson, chairman of the board, stated.

Study Oil Recovery

The Oklahoma University Research Institute is studying better ways of recovering oil under a $11,500 contract with the American Petroleum Institute, beginning July 1. Findings will be made available to the public.

Dr. John C. Calhoun, Jr., chairman of the petroleum engineering school will direct work, assisted by one full-time scientist and two part-time graduate students.

Shareholders Told Earnings May Drop

Unless market conditions improve suddenly, stockholders in many cases are advised that company incomes can be expected to tumble. The 1949 financial statements may look slightly anemic beside the healthier ones of 1948, several leading oil companies are warning their stockholders.

They present the possibility, however, that stockholders may benefit from more liberal cash dividends, as there won't be so much capital plowed back this year into expansion and improvements, and the push of the oil industry to meet higher postwar demands is nearing an end. Chairman of the Board of Standard Oil Company (New Jersey) advised stockholders that the company's earnings for the first half of July 1949 may be 30 per cent lower than the same period last year. The American Petroleum Institute seem to bear out Abrams' prediction of anticipated income declines, in a report for the weeks ending May 28, 1949, and May 29, 1948. The comparison shows two definite trends: (1) All production and refining operations, with the exception of gasoline production, are well below 1948. (2) Refined productions far exceed those of a year ago.

Capital Outlay Less

According to figures compiled by the American Petroleum Institute, the oil industry will spend slightly less on expansion and modernization this year than 1948.

Capital expenditures will probably be over $2,100 million this year, compared with the peak expenditure of $2,300 million spent by oil companies last year.

It is expected that about 50 per cent of total capital expenditures this year will be on production facilities.

IPAA Releases Import Data

Figures released by Independent Petroleum Association of America indicated imported crude oil retards domestic production. Continuation of the trend will result in curtailment of all branches of the industry, the report said.

For the first quarter of 1949 the average daily import volume of crude coming into the United States was some 580,000 bbl. This figure is greater than the United States Bureau of Mines total demand forecast for the month of March for the States of New Mexico, Mississippi, Arkansas, Colorado, Michigan, Pennsylvania, Montana, Kentucky, Indiana, New York, Ohio, West Virginia, Nebraska and other lesser important producing states for which the forecast demand was 566,000 bbl daily.

Oil Field MACHINERY

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CHICAGO

LAUGH WITH BARNEY

"Now, Eliza, as I understand this case you and Rastus had a drunken altercation and you were kicked in the ensuing rumpus?"

"No, sah, mistah Jedge! Ah was kicked in de stummick!"

A young would-be salesman said farewell to his dubious wife and started off on his first road trip. A month had elapsed when his wife received a wire: "Been given a raise. Quite a feather in my cap."

She heard nothing more for several weeks, then received another telegram: "Made District Sales Manager. Another feather in my cap."

About a week later the wife received this telegram: "Fired. Send train fare back." She replied: "Use your feathers and fly home!"

* * *

A man walked into a cocktail bar for a drink and noticed a chap sitting alone at the other end of the bar talking to himself.

He asked the bartender what was the matter with the fellow. The bartender replied: "Oh, he comes in here, buys a drink and sits alone telling himself stories."

The man asked: "What does he mean when he waves his hand every now and then, in disgust?"

The bartender replied: "He does that every time he tells himself one he heard before."

* * *

"Lady, you'll have to pay full fare for that boy. He must be over twelve."

"How can he be—when I've been married only ten years?"

"Listen, lady. I collect fares— not confessions."

* * *

A mother and her daughter boarded a street car in Columbus and the youngster ran to the farebox, grabbing the lever.

"Let me put the ticket in, mother," she said.

"No, honey, I'll take care of it," the mother replied firmly.

"No," said the little girl, "You can put it in and I'll flush it."

* * *

The great big beautiful car drew up to the curb where the cute little working girl was waiting for the bus. A gentleman stuck his neck out and said, "Hello, I'm driving west."

"How wonderful," said the girl. "Bring me back an orange."

The charming lady operator of a famous flea circus decided to widen the scope of her activities and began to train some pet termites. Termites, as most readers doubtless know, are super duper ants.

One day the lady discovered that her termites were listless and unwilling to go through their usual paces. Ordinarily they would pulverize tin cans for her with seeming joy, but on that particular day they would eat nothing but soft wood.

So she called an insect doctor, who of course was equipped with a specially sensitive micro-strethoscope with which he listened attentively to the rumblings of the insect's organisms. He heard sounds forthwith that were much like the panting of a dog that has been chasing a rabbit on a hot day. In due course, after considerable meditation and repeated intent listenings he announced, "Lady, you have pants in your ants."—W.F.S.

* * *

"Ah," said the customs officer, finding a bottle of whiskey, "I thought you said there were only old clothes in this trunk?"

"Aye, that's my night cap."

* * *

"At last," groaned the elderly diner, "total paralysis of the left leg! I've feared it for years."

"If it will relieve your mind any," whispered the sweet and more or less demure young thing on his left, "it's my leg you've been feeling."

* * *

A youngster was asked by his history teacher to name the principal cultural contribution of the Phoenicians.

He answered, "Blinds."

* * *

"Everybody laughed when I sat down at the piano, but when the little red-headed contralto gave me the key to A flat—boy, how I accompanied her!"

* * *

The judge had just sentenced Pancho to die in the electric chair. The judge whispered, "May peace be on your soul, may peace be on your soul."

Pancho dropped his head in shame and said slowly, "Peace on you, too, Judge."

* * *

Old lady (to little boy smoking): "You better stop doing that or you'll never be President of the United States."

"I never will be anyway, lady, I'm a Republican."

FOR BETTER CUMMINS DIESEL SERVICE

AT ODESSA SERVING HIGHWAY 80

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GENUINE CUMMINS DIESEL PARTS

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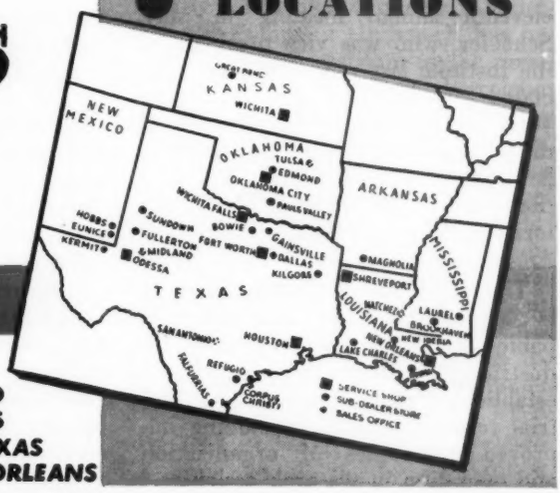
The extensive network of service facilities for Cummins Dependable Diesels constantly is being expanded and improved. This assures users of famous Cummins Diesels prompt, efficient service—24 hours a day—by men with the "know-how," tools and equipment for every type repair job. Our new service shop at Odessa, Texas, is centrally located on Highway 80, where it is easily accessible to all types of rolling stock. From this shop operate Cummins Service Trucks to provide expert service where it is needed in the surrounding oil fields. Availability of superior service results in a saving of time and money for users of Cummins Diesels . . . is just one of the many reasons why it will pay you to standardize with Cummins Dependable Diesels!

ONE OF THE FLEET OF CUMMINS SERVICE TRUCKS OPERATING OUT OF THE NEW ODESSA SHOP ON HIGHWAY 80, PROVIDING EXPERT DIESEL SERVICE FOR THE OIL FIELDS.

- STRATEGIC
- SERVICE
- LOCATIONS



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PERSONALS

▸ **C. E. Streeter,** Bradford, Pennsylvania, oil producer, was elected the eleventh president of the Pennsylvania Grade Crude Oil Association at a board of directors' meeting which followed the association's 26th annual meeting. He succeeds D. T. Ring of Columbus, Ohio, association president since 1946.

Two new directors were also elected at the annual meeting.

They are **D. O. Laycock,** Washington Oil Company, Taylorstown, Pennsylvania, and **J. R. Corbett,** Cato Oil and Grease Company, Oklahoma City, Oklahoma.

Ralph T. Zook of Bradford, Pennsylvania, a former president of the association was elected an honorary director and member of the association for life.

Other officers were chosen:

George J. Hanks, president of South Penn Oil Company, Bradford, first vice president; **James D. Berry, Jr.,** "D" Oil Company, Oil City, second vice president.

John H. Schaefer

▸ **John H. Schaefer,** Ethyl Corporation vice president in charge of manufacturing, was elected president of the Industrial Research Institute at the eleventh annual meeting in May. Schaefer, who was vice president of the Institute last year, has been associated with Ethyl Corporation for 23 years and has been a vice president of the company since 1943. As president, he succeeds E. W. Engstrom, vice president of research, RCA laboratories division, Radio Corporation of America.

The Industrial Research Institute is composed of more than 110 companies representing widely varied industries. It is interested primarily in establishing high standards in industrial research and in developing improved techniques of organization and operation in research activities.

Hoyt Sherman

▸ **Hoyt Sherman,** has been named president of The Mene Grande Oil Company, Venezuelan affiliate of Gulf Oil Corporation.

Sherman has been vice president since 1947, and succeeds Chester M. Crebbs who during his 26-year administration transformed the company from a relatively small organization into one of the "big three" of Venezuela.

Sherman brings to his new duties a broad knowledge of Venezuela's oil business, based on 21 years' experience with Venezuela Gulf and Mene Grande.

Sherman was graduated from Harvard University, and immediately after graduation from college, he entered the Army, serving two years as an infantry officer in France. In 1919 he entered the employ of the New England Oil Company and for the next few years served in various capacities with that company, chiefly in connection with their interests in Mexico and Venezuela.

He joined the Gulf Oil Corporation in the New York office as assistant to C. W. Hamilton, now vice president of the New York production division, in charge of foreign operations.

He came to Venezuela in 1928 as assistant manager of Venezuela Gulf, whose main offices were then in Maracaibo.

After a transfer of the assets of Venezuela Gulf to the Mene Grande Oil Company and the removal of its main offices to Caracas, Sherman was appointed general manager.

Robert L. Boggs, until recently division manager in Western Venezuela, replaces Sherman as vice president. An employee of the Gulf companies since 1927, Boggs came to Venezuela in 1928, and served as production engineer, chief petroleum engineer, and executive assistant. In 1939 he was made assistant to the president of the Mene Grande Oil

Robert L. Boggs

Company in Caracas, and in 1946 was transfered to San Tomé as general superintendent and assistant manager of the Eastern Division.

During the past year, Boggs temporarily relieved the manager of the Western Division while the latter was on vacation. He then attended a course in Advanced Management at Harvard before returning to Caracas to take up his new duties as vice president.

▸ **Stanley Learned** has been elected director of the company and a member of the executive committee by the Board of Directors of Phillips Petroleum Company.

This fills the vacancy of the Board created by the recent death of Ch. A. Lemp of St. Louis, Missouri, and the vacancy on the executive committee created by the recent retirement of Frank Phillips.

James MacPherson

▸ **James MacPherson** has been appointed vice president and general manager of The American Independent Oil Company's operations in the Kuwait-Saudi Arabian neutral zone in the Persian Gulf.

MacPherson was formerly vice president and resident manager of Arabian American Oil Company, a part of the Standard group.

▸ **H. J. Struth,** veteran oil economist and analyst, has been appointed assistant director of the department of information of the American Petroleum Institute, succeeding Robert E. Allen, who resigned effective May 31.

Struth joined the Institute staff last January, coming to New York from Dallas, Texas, where he originated and edited the first two editions of the Petroleum Data Book for the Petroleum Engineer Publishing Company.

Widely known as an oil economist, Struth has been in the oil business for 30 years. He has written many papers on oil economics.

In his new position, Struth will work under the direction of H. B. Miller, director of the Department of Information, and will serve as his administrative aide in the functioning of the department.

Prior to the 2½ years that Struth spent with *The Petroleum Engineer,* he was with the Mid-Continent Oil and Gas Association as an economist and administrative aide for 10 years. During the NRA days of the early '30's, he was technical adviser to the Petroleum Administrative Board in Washington.

▸ At a regular meeting of the Board of Directors of the Gulf Oil Corporation **W. A. Berryman, Willard F. Jones,** and **Thomas J. Sullivan** were elected vice presidents. Following this announcement, the appointment of **Bonnar H. Barnes** as general manager of refineries was made.

Berryman, newly-elected vice president and assistant general manager of foreign marketing, joined Gulf in 1933 and was sent to Belgium where he was concerned with the development of markets for Gulf products in Western Europe. While in Antwerp he was elected a director of several Gulf subsidiary companies engaged in foreign sales.

Jones, the new vice president in charge of marine operations, has been an employee of the Gulf Marine Department for 46 years. He served in various capacities from 1903 until 1913, when he was appointed purchasing agent for the marine department. During World War I he was promoted to assistant marine superintendent, and in 1929 he was named superintendent.

Sullivan, the new vice president in charge of manufacturing, began his term of Gulf service in 1921 when he was employed as a foreman of the acid plant at the company's Port Arthur, Texas refinery. Nine years later he was promoted to assistant general superintendent of this plant, and in 1935 he was appointed general superintendent of Texas refineries with plants at Port Arthur, Sweetwater, and Fort Worth under his supervision.

Barnes' employment with Gulf dates back to 1921 when he was employed as a chemist. In 1929 he was promoted to superintendent of the refinery at Sweetwater, Texas. Two years later he was transferred to Toledo, Ohio, as superintendent of the Gulf refinery there. He was appointed general superintendent of the company's three plants in Texas later, a position he held until 1945 when he was brought to the Gulf general offices in Pittsburgh as assistant general manager of manufacturing department.

Donaldson Brown, J. F. Drake, H. A. Gidney, Richard K. Mellon, W. L. Mellon, J. E. Nelson, David Proctor, Alan M. Scaife, and **S. A. Swensrud** were reelected directors of the company.

Alden S. Donnelly

▸ **Alden S. Donnelly,** of Midland, Texas, was elected a vice president and a member of the board of directors of Honolulu Oil Corporation at the recent annual meeting of the stockholders of the organization held in San Francisco, California.

Donnelly has been general superintendent of Honolulu's Mid-Continent division for several years, and will now be manager of operations for the division. He is a graduate of the Colorado School of Mines with a degree in geological engineering.

He has been employed as a geologist, scout, development geologist, division engineer, and general superintendent successively, and has been located in the division headquarters in Midland since he joined Honolulu in 1928.

▸ **Robert W. McDowell** has been elected president of the Mid-Continent Petroleum Corporation. He has been executive vice-president.

He takes over the duties which Jacob France, chairman of the board, had been fulfilling since illness a year ago forced F. B. Koontz to give up the position of president.

▸ **Percy C. Spencer,** president, Sinclair Oil Corporation, has received the honorary degree of Doctor of Laws from the University of Wyoming. His citation pointed out that he was an adopted son of Wyoming, a distinguished lawyer, business executive, and citizen. His high position in the oil industry is a tribute to his intelligence, industry and character, the citation said.

Spencer came to New York in 1934 as a member of the legal department of Sinclair Oil Corporation. In 1946 he became general counsel, and was elected president this year.

▸ **Lew Wentz,** pioneer Oklahoma oil man, died in Ponca City, Oklahoma June 9. Wentz was active in the development of many Oklahoma oil fields, including the Blackwell field. He was formerly head of Wentz Oil Corporation, closing the firm several years ago to operate as an independent.

A national political figure, Wentz served as Republican national committeeman for Oklahoma.

▸ **J. G. Stevens** was elected to the position of executive vice president and treasurer of Douglas Oil, recently by the Board of Directors.

Sam Goldman was elected vice president in charge of marketing, **William F. Lyte** vice president in charge of asphalt sales, **John J. Stanko** vice president in charge of research and asphalt specialties and **L. A. Whitlock** vice president in charge of refining. All had been associated with Douglas Oil in executive capacities.

D. L. Commons, formerly assistant secretary, was elected secretary; and **G. E. Clarke** was elected assistant secretary. **Earl S. Sharp** was made assistant to the president.

All directors were re-elected.

▸ **Roy J. Diwoky,** formerly of Standard Oil Company (Indiana), has become executive assistant to the president of Pan American Petroleum Corporation, it was announced by Bruce K. Brown, president of Pan-Am.

Diwoky will be located at the New Orleans, Louisiana, headquarters of Pan-Am, and will serve as a director of that corporation. Diwoky a graduate of the University of Iowa, became associated with the Standard Oil Company (Indiana) in 1935. After five years of service in the research department, he transferred to the manufacturing department in 1940, where he rose to the position of assistant general superintendent of the Whiting, Indiana, refinery.

▸ **Elmer C. Rogers,** Union Oil Company of California, has been elected president of the Petroleum Accountants Society of Los Angeles. He has many years of experience in the field of oil accounting and at present heads the marketing accounting division of the company he represents.

Other officers elected are: first vice president, Harold D. Osborn, General Petroleum Corporation; second vice president, Fred S. R. Sedding, Doheny-Battson Interests; secretary-treasurer, J. R. Brown, Standard Oil Company of California. A new director, E. M. Jacobs, The Texas Company, was elected to fill a vacancy.

▸ **Frank Adair Leovy,** formerly vice-chairman of the board and a director of Gulf Oil Corporation and chairman of the board and a director of Gulf Refining Company, died at his home June 2.

Leovy had also been president and a director of a number of subsidiary Gulf companies. He had retired from all his official positions with Gulf in 1946.

An outstanding figure in the oil business, Leovy began his 42-year association with Gulf at Beaumont, Texas, in 1904, holding many responsible positions in the production and pipe line departments of the Gulf Companies in Texas and Oklahoma. In 1914 he was transferred to Gulf's executive offices in Pittsburgh, Pennsylvania, from where he directed the production and pipeline activities of the companies in the United States and abroad.

▸ **Charles Roy Auster,** after 45 years with the company, assistant purchasing agent in charge of domestic assignments, is retiring July 1 from Socony-Vacuum Oil Company, Inc. **Earl W. Beck,** assistant purchasing agent in charge of foreign assignments, becomes assistant in charge of both domestic and foreign purchasing.

Beck has been associated with the company since 1923, beginning work with General Petroleum Corporation, Los Angeles, an affiliate of Socony-Vacuum. He became manager of purchases at General Petroleum in 1937. He was transferred to Socony-Vacuum in 1946.

▸ **L. H. Prichard,** chairman of the board of directors of the Anderson-Prichard Oil Corporation, died June 19. He was 65 years old.

Prichard entered the oil business as a broker in 1915 and in 1921 became an independent operator. Later that year he formed a partnership with J. Steve Anderson.

Officers and Committeemen for 1949, Dallas Chapter of Nomads. Front row: C. A. McClelland, charter member; J. C. Baseheart, president; Brad Mills, regent; C. J. Berlin, secretary; J. A. Mussler, membership. Back row: E. J. Whetzle, treasurer; Vic LeMay, entertainment; A. J. Olson, sergeant-at-arms; E. J. Shiels, assistant secretary; J. E. Everroad, membership. Other officers not shown are R. J. Bauer, vice president; Earl Smith, assistant sergeant-at-arms, and F. I. Brinegar, regent.

▸ **Oscar John Dorwin** of The Texas Company has been elected chairman of the American Petroleum Industries Committee of the API succeeding Edwin S. Hall, who retired last March. Dorwin is general counsel of The Texas Company and has been a member of the APIC since June, 1944.

A native of Wisconsin, Dorwin graduated from the University of Notre Dame in 1917 and then entered Harvard Law School. He practiced law for five years in Chicago before becoming associated with the Indian Refining Company at Lawrenceville, Illinois, as counsel. He later became chief attorney for that company which was acquired by The Texas Company in January, 1931. He became general counsel in April, 1944.

▸ **F. J. Schempf** has been named division manager for Stanolind Oil and Gas Company's Texas-Louisiana Gulf Coast division at Houston, Texas, and **C. T. Jones** has been named to head the central division at Oklahoma City, Oklahoma.

Schempf, who has headed the central division, is succeeding R. E. Nelson, Jr., who has resigned to become assistant to the president of Stanolind Pipe Line Company at Tulsa, Oklahoma.

Schempf joined Stanolind in 1933 as a helper on a torsion balance crew, and has held various geological posts including that of division geologist for the North Texas-New Mexico division, and division manager of exploration for the Texas-Louisiana Gulf Coast division. He has a degree in geology from the University of Wisconsin.

Jones started with Stanolind in 1934 as a surveyor on a seismograph party. Later, he served as geological scout and geologist before becoming district geologist at Wichita, Kansas. He served during the war as a colonel in the Army Corps of Engineers. He became manager of the foreign exploration department when it was organized in November, 1947. Jones was graduated from Missouri School of Mines with a degree in mining geology.

▸ **Walter Miller,** 68, retired vice president of Continental Oil Company, died at his home recently. His death closed a 30-year career with the petroleum industry, 24 of the years with Continental. Miller was a native of Switzerland. He retired on March 1, 1946.

Available sixty day notice. Graduate Engineer—electrical, mechanical, structural, heating and air conditioning design, field engineering, cathodic protection. Executive ability. Wants position with opportunity for advancement. For complete record write Box 101, c/o THE PETROLEUM ENGINEER, P. O. Box 1589, Dallas, Texas.

OIL and GAS TRADE NEWS

New Agents Announced For McKissick Corp.

McKissick Products Corporation of Tulsa, Oklahoma, has announced a change of agents in the Gulf Coast area. Martin-Davis Company, Houston, Texas, will represent them in the Texas Gulf Coast area. H. Eugene Thomas, New Orleans, will be the representative in the Louisiana Gulf area.

The Martin-Davis Company is a newly formed company consisting of J. L. Davis of Houston and L. K. "Red" Martin of Corpus Christi. Headquarters of the Martin - Davis Company will be in Houston, Texas, and an office will be maintained at Corpus Christi, Texas.

Holds Annual Meeting

A four day sales and service meeting has just been concluded at the Tulsa, Oklahoma, plant of Fred E. Cooper, Inc., where a number of new spudders and drawworks units were inspected and demonstrated. Besides the Cooper force, engineers from several suppliers led technical discussion on new equipment and uses.

At the conclusion of the meeting, the Board of Directors announced the appointment of J. W. Allen as general manager of the company. The board also has accepted the resignation of Harold E. Cooper as an officer of the company.

Allen formerly was vice-president in charge of engineering and manufacturing of Cooper-Allis-Chalmers well servicing equipment, draw works, spudders and power units.

J. H. Swope, president employees' union, presents testimonial to Morris E. Leeds. Watching are Robert Craig, president co-operative association, left; C. S. Redding, president, and Mrs. C. Redding, right.

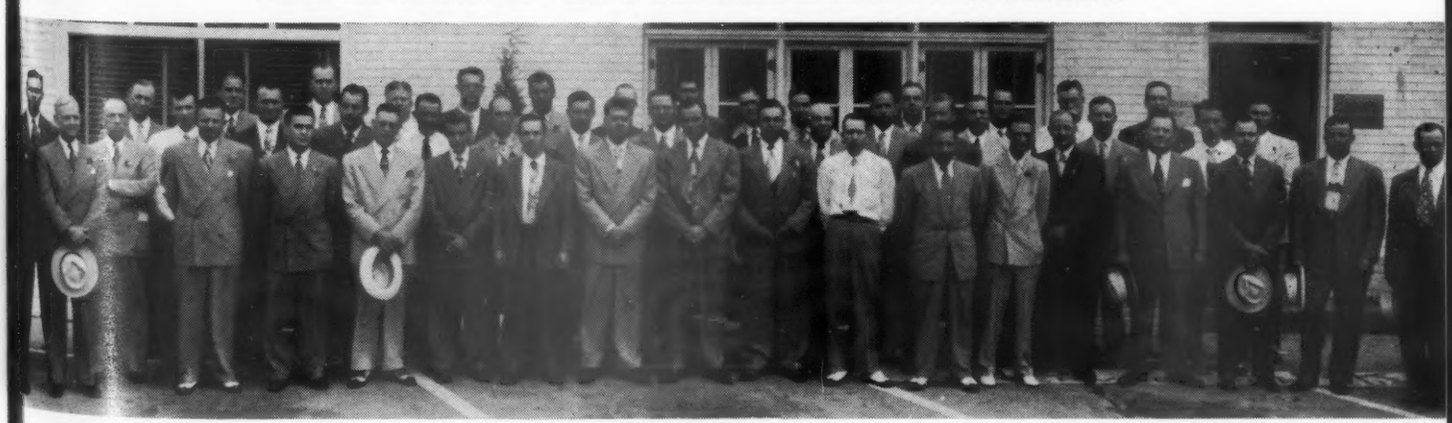
Celebrates 50th Anniversary

Celebrating the firm's 50th anniversary, the Leeds and Northrup organization held its birthday party in Philadelphia, Pennsylvania's convention Hall, June 4.

The firm was founded by Morris E. Leeds in 1899, to provide an American source of electrical measuring instruments then made only in Europe. In the 50 years which have elapsed, the company has become a source of supply for such equipment known throughout the world. The social and business concepts of Leeds have brought many awards to the company and to him personally. His highest award came in 1949 from the American Institute of Electrical Engineers who presented him with the Edison medal for scientific achievement.

The company now employs approximately 2000 men and women at its plant at Philadelphia, and its 14 district offices throughout the country.

Pictured below is a group of executives, and field representatives of the Hughes Tool Company of Houston, Texas, taken during a recent two-state meeting in Enid, Oklahoma. Present at the meeting were all of Hughes field representatives in Kansas and Oklahoma and several executives from the main office in Houston.



Holds Open House

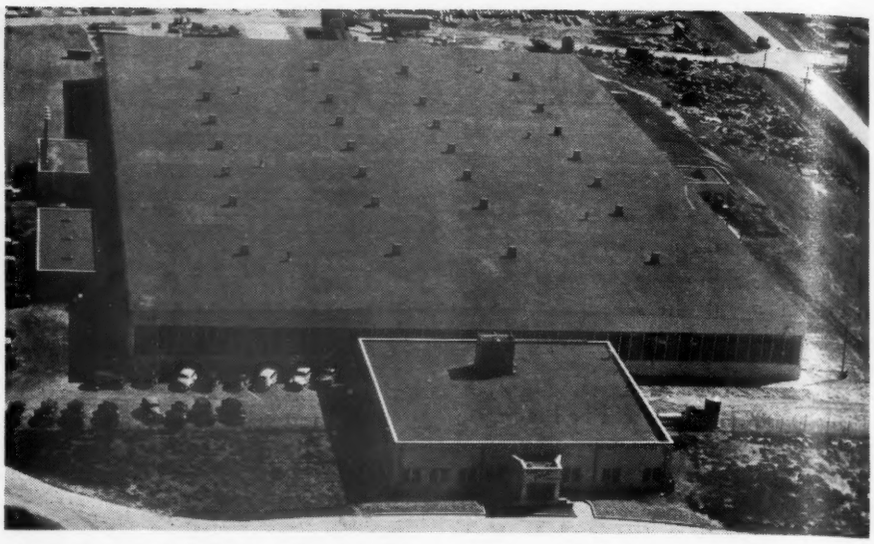
Celebrating the official opening of Dresser Industries, Inc., Cleveland, Ohio's, new division offices and service depot in Houston, Texas, an open house party recently marked the completion of these new facilities. The party was attended by more than 600 guests in the oil and gas industry and a number of Dresser officials, who inspected the new Gulf Coast headquarters, remodeled by the W. S. Bellows Construction Company. Remodeling was under the personal supervision of Richard Porter Brown, Dresser Industries, and George Bellows, who superintended the work for the Bellows Company.

The new facilities will presently serve as the Gulf Coast headquarters for Dresser and five of its oil and gas equipment manufacturing subsidiaries: Clark Bros. Company, Inc.; International Derrick and Equipment Company; Security Engineering Company, Inc.; Pacific Pumps, Inc., and Kobe, Inc.

Appoints Agent

Link-Belt Company announces the appointment of Bettis Corporation, Casper, Wyoming, as stock carrying distributor of Link-Belt Vibrating Mud Screens (Shale Shakers).

The Bettis Corporation, Houston headquarters, has been handling the distribution of replacement parts for these shakers in Mid-Continent and Gulf Coast areas for the past 19 years.



New home of Fritz W. Glitsch and Sons, Inc., recently moved to Dallas, Texas. The company fabricates bubble trays and caps for the petroleum industry.

Supply Store Opened

Bethlehem Supply Company announces the June 1 opening of a new and modern oil field supply store at Snyder, Texas. The Snyder store will carry a full stock of oil field drilling and production equipment.

Moves Laboratory

The industrial applications laboratory of The Dow Chemical Company moved from Ann Arbor, Michigan, to Bay City, Michigan.

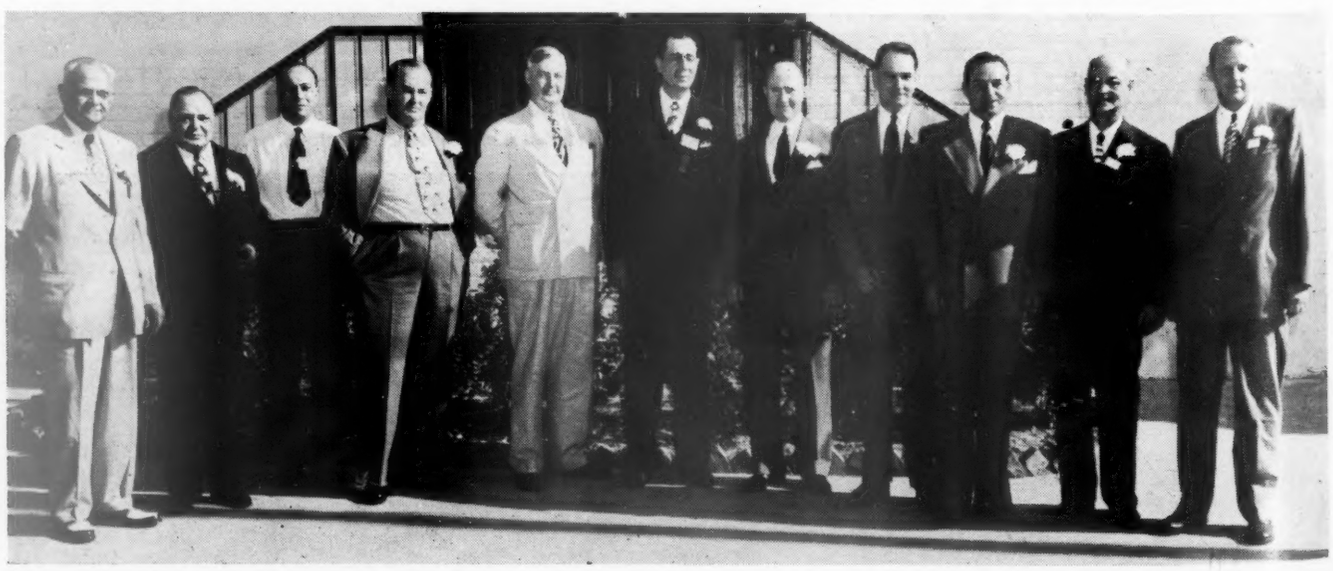
Laboratory director, Dr. O. C. Cessna, his assistant, Edward O. Ohlmann, and six other employees made the shift.

Expands Facilities

M. O. Johnston, president of Johnston Oil Field Service Corporation, a Texas corporation, Houston, Texas, is pleased to announce that the corporation under management of W. B. Taylor, vice president, has acquired assets and service facilities in Andrews, Kermit, Midland, Odessa, San Angelo, and Snyder, West Texas, and Hobbs, New Mexico, from the M. O. Johnston Oil Field Service Corporation.

Both corporations have heretofore been servicing oil field testing tools, gun perforation, pressure recorders, packers and adjustable flow beans.

Attending the Dresser Industries, Inc., open house in Houston, Texas, are: Richard R. Bloss, vice president and general manager, Texas Division, International Derrick and Equipment Company; C. P. Clark, president, Clark Bros. Company, Inc.; F. W. Laverty, general sales manager, Clark Bros.; Robert M. Cook, vice president, Security Engineering Company, Inc.; Warren S. Bellows, president, W. S. Bellows Construction Company; Thelmon D. Collins, vice president, IDECO supply stores division, International Derrick and Equipment Company; Oscar M. Havekotte, president and general manager, International Derrick, Cleveland, Ohio; Ferguson Barnes, vice president and general manager, Columbus division, International Derrick; Otto Hammer, president, Security Engineering; David E. Hutchcraft, vice president and director of sales, Clark Bros., and R. G. Ralph, Mid-Continent division manager, Kobe, Inc., at Oklahoma City, Oklahoma.



Distributors Named

Oil Base, Inc., manufacturers of OB Mud Guns, has appointed Mud Products, Inc., of Tulsa, Oklahoma, as their representative for mud guns in the Mid-Continent. E. R. "Dick" Albert, Jr., of Mud Products, Inc., will be in charge of sales and service. West coast distribution and export for OB mud guns will continue to be handled through Oil Base, Inc., Compton, California.

Lapp Made Salesman

Farrel-Birmingham Company, Inc., anounces an association with C. A. Lapp and Company, Cleveland, Ohio, who will handle the sale of Farrel gears and gear units in Cleveland.

C. A. Lapp, who will devote his personal time to this sales endeavor, is well known to manufacturers in Northern Ohio, having represented W. R. McDonough and Company, manufacturers' agent, in this area from 1942 until December, 1948.

Distributors Selected

Franklin Supply Company, Chicago, Illinois, has been appointed distributor in Illinois, Indiana, Michigan and Kentucky for Bethlehem Supply Company machinery, according to Larry Harper, Franklin vice-president in charge of the Mid-Continent area, Tulsa.

Products to be handled by the firm include pumping units and rotary drilling equipment.

Watts, Payne Honored

Watts, Payne-Advertising, Inc., of Tulsa, Oklahoma, has been elected to membership in the American Association of Advertising agencies, making this the first advertising firm in Tulsa to receive this honor.

The agency, established in 1930, is headed by Don Watts, as president, and is a member of the Southwestern Association of Advertising Agencies.

Appoint Sales Agents

The Guiberson Corporation has announced the appointment of Daniels, Beckley and Associates, Inc., to serve as foreign sales representatives for Guiberson oil field equipment.

Canadian Service Branch

The McCullough Tool Company, Los Angeles, announces the opening of its first Canadian service branch in Edmonton, Alberta.

The new branch is under the managership of Norman Brookes who is assisted by two service engineers, Verl J. "Heavy" Sanders and Stan Hendrickson. Brookes has been with McCullough for 11½ years and previously was in charge of the Bakersfield, California office.

All the regular McCullough services are now available for the first time in Canada on a 24 hour a day, 7 days a week basis.

This is the 28th McCullough service location. The other 27 branches are strategically located in the Gulf Coast, Rocky Mountain and Pacific Coast oil fields.

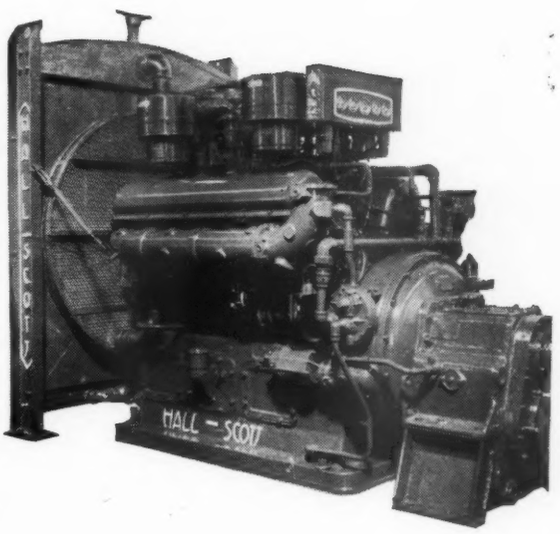
I. J. McCullough, president of the McCullough Tool Company, reports that two complete service trucks are now operating in Edmonton and others will soon follow.

Win Essay Prizes

At the summer meeting of the Hydraulic Institute at Absecon, New Jersey, recently, awards were made to A. M. Shaw and Roy Carter of Worthington Pump and Machinery Corporation for their papers entered in the Institute's sixth annual engineering essay contest. Shaw's award was for his paper in the technical group on Phenomena of Viscous Flow and was judged second of those in that group. Carter's paper on Starting Torque Characteristics of Centrifugal Pumps received first prize in the Practical Papers group.

Whatever the application...
count on HALL-SCOTT POWER

ROTARY DRILLING RIGS
PUMPS
GENERATORS
GATHERING SYSTEMS
INDUSTRIAL EQUIPMENT
STAND-BY SERVICE
RECYCLING PLANTS
BOOSTER EQUIPMENT



Count on Hall-Scott Engines for *dependable* power! They have been tested and proved in every type of application in pipe line, refinery, and field.

Count on Hall-Scott Engines for *economical* power! Unit construction means quicker servicing, minimum downtime. Compact design and high h.p. to weight ratio permit greater mobility and lower transportation costs.

Both the Hall-Scott V-12 and the Series 400 "sixes" are adaptable to gas, butane, or gasoline operation. Full details on request.

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HALL POWER BY SCOTT

New Design Feature
CHAPMAN VALVE
List 960

Gives more than 50% increase in strength of stem and wedge gate connection...meets the most extreme operating conditions.

Valve stems and gates with the new scientifically designed connection are interchangeable with all List 960 Valves now in service

Here's one more result of the year after year program of research which Chapman carries on to make the List 960 *tops for toughness.* Reason why this small gate valve can lower your maintenance cost — give you more years of useful valve life.

Consistently you will find the Chapman List 960 is *your best valve buy.* It is available in sizes ¼" to 2" . . . rising stem with yoke (as illustrated). Also available rising stem inside screw type. For pressure range 2000 lb. at 100 deg. F., 380 lb. at 1000 deg. F.

For higher pressures specify List 990.

Secret of this 50% increase in strength of the stem and wedge gate connection lies in its new design which compensates at points where excessive stresses can develop.

And don't forget the wear resisting and non-galling properties of the hard heat treated seat rings and the 800 Brinell hardening of the wedge faces by the exclusive Malcomizing Process.

The Chapman Valve Mfg. Co., Indian Orchard, Massachusetts

TRADE PERSONALS

John "Jack" Hufnagel has been appointed manager of the Kaskade Tray division of the Koch Engineering Company, Wichita, Kansas. Hufnagel was formerly with Hydrocarbon Research, New York City.

Perry Kilsby Inc., Los Angeles, California, has been appointed Pacific Coast representatives for Koch Kaskade fractionating trays.

Mud Control Laboratories, Inc., Oklahoma City, Oklahoma, have announced the following changes in personnel: **J. G. Vaughn,** formerly with Baroid sales division in Michigan, is in charge of the Oklahoma City laboratory. **Donald J. Keen** has been named distribution manager in charge of warehouses. In Oklahoma, **Foy Smith,** service engineer, has been transferred to Ardmore. **Joe Rodolph,** service engineer, has been transferred to Duncan, Oklahoma. **R. W. Blakey,** service engineer, has been transferred to Guthrie, Oklahoma.

In the Rocky Mountain region, **Kenneth Jones,** service engineer, has moved to Cortez, Colorado. **Harold F. Lloyd** has been named warehouse distributor at Cortez. **S. J. Putman** has been employed as service engineer at Vernal, Utah.

Thomas J. Williams of Houston, Texas, has been appointed as a new sales engineer in the southwestern states by Edward Valves, Inc., East Chicago, Indiana.

Williams was formerly employed by Pate Drilling Company in Texas and previous to that he had experience with The Texas Company. During the war he served in the Army Air Force, spending over two years in the South Pacific.

He will make his headquarters in Tulsa, Oklahoma, with the Rockwell Manufacturing Company. From there he will serve Edward valve users throughout the Southwest and assist Edward representatives on specific projects.

Grover Ellis, Jr., has been added to the oil loan deparment of the First National Bank in Houston, Texas, P. P. Butler, president, has announced. Ellis graduated from the University of Oklahoma, and the Harvard School of Business Administration. During the war, he served with the U. S. Navy.

T. P. Latimer has joined Clark Bros. Company, Inc. in the Turbo-Machinery sales division. He became affiliated with Clark Bros. at Olean, New York, upon graduation from Cornell University.

A. G. Van Campen, who has been a sales engineer in the New York office was promoted to district manager of the Chicago, Illinois, office recently. Van Campen joined Clark Bros. in 1936 in the experimental engineering department.

R. C. McDonald has been transfered from an associate company, Pacific Pump Works, to Clark's New York office to fill the vacancy left by Van Campen. McDonald joined Clark's Pacific Pumps, Inc. as a sales engineer in their New York office in 1946.

Arch F. Campbell of General Motors Corporation, Tulsa, Oklahoma, recently returned from a three weeks trip to Venezuela. He visited the company's branch in Caracas, diesel engine oil field dealers, and users of General Motors diesels in Venezuela.

Olin L. Medley, a graduate of the University of Oklahoma, has joined the sales engineering staff of Black, Sivalls and Bryson's Shreveport, Louisiana, branch.

Joe Beggs, who has managed the company's branch at McPherson, Kansas, for the past 12 years, has been transferred to the managership of the Ellinwood, Kansas, branch. **Winston O. Shook** from the Hays, Kansas, branch is now branch manager at McPherson. **M. F. "Mike" Barnes,** formerly of Ellinwood, has been transfered to the sales division and will be stationed at the regional offices at Great Bend. **Charles W. Stevens** from Odessa, Texas, has been transferred to San Angelo where he will act as sales representative.

Roger W. Batchelder has been appointed vice president in charge of sales of the National Bearing Division of American Brake Shoe Company, according to an announcement by T. W. Pettus, division president. He will continue to be located at division headquarters in St. Louis, Missouri.

Batchelder, formerly assistant to the president of National Bearing, has been with Brake Shoe since 1933.

S. G. Paddock

H. A. Dietrich

S. G. Paddock, who has been with Burgess Battery Company, or its subsidiaries for the past 14 years, has been appointed sales manager of the petroleum division of the Burgess-Manning Company, Libertyville, Illinois.

H. A. Dietrich, who has been with the company since 1945, has been made sales manager, railroad division, of Burgess-Manning.

Harold Bottomley, formerly chief process engineer for The Refinery Engineering Company of Tulsa, Oklahoma, has recently been appointed a vice president of the company, according to T. M. Lumly, president. Bottomley joined the company in 1947.

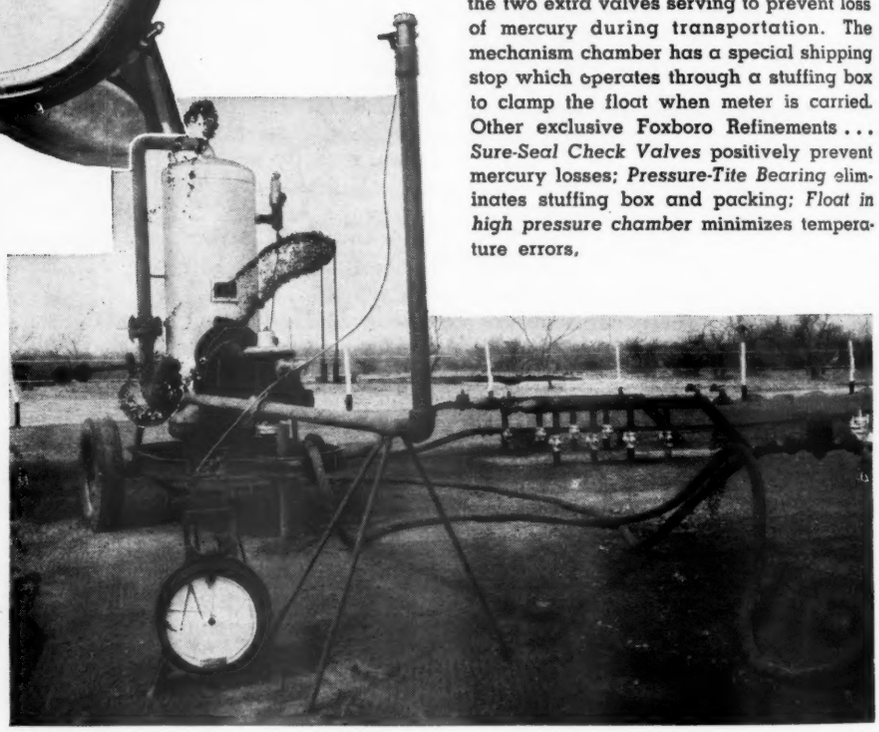
Frank E. Rath has been named works manager of Spang and Company, manufacturers of cable-system drilling. Rath comes to the Spang organization from the Carnegie-Illinois Steel Corporation, having been chief engineer of the Duquesne Works of that company.

EASIER TO CARRY THAN AN OUTBOARD MOTOR

THIS FULL-FLEDGED, *Portable Flow Meter* Weighs only *35* Pounds

The Foxboro Portable Flow Meter is equipped with a 5-valve piping manifold; the two extra valves serving to prevent loss of mercury during transportation. The mechanism chamber has a special shipping stop which operates through a stuffing box to clamp the float when meter is carried. Other exclusive Foxboro Refinements . . . *Sure-Seal Check Valves* positively prevent mercury losses; *Pressure-Tite Bearing* eliminates stuffing box and packing; *Float in high pressure chamber* minimizes temperature errors.

Portable Flow Meter Installation on Portable Well Tester



NO WONDER there are so many of these portable flow meters in use throughout the oil fields! They're designed for portability, but without compromise in accuracy. They're light . . . weighing but 35 lbs., since the case and frame are made of aluminum alloy . . . yet each leader is ruggedly constructed for severe field service. Meter chambers are forged steel for 500 or 1000 lbs. working pressure. Differential range is 100" of water...static range as desired.

For checking gas-oil ratios to prevent excessive depressuring, for measuring or prorating gas from leases or wells, for temporary replacement of damaged meters or for semi-permanent installations... you can't beat the convenience, accuracy, and serviceability of this Foxboro Portable Flow Meter.

Get all the facts about the unique and exclusive features of this flow meter. Write **The Foxboro Company, 130 Neponset Avenue, Foxboro, Mass., U. S. A.**

FOXBORO
REG. U. S. PAT. OFF.

DIFFERENTIAL-TYPE FLOW METERS

Robert Harcus

Frank D. Smith

▸ **Robert Harcus** has been appointed general manager of International Cementers, Inc., it was announced by E. S. Dulin, president of Byron Jackson Company. Harcus, who succeeds John Chesnut, has been with Byron Jackson Company since 1945, and active in the development and application of shaped charges in the oil industry. Before joining Jackson Company, he was in Burma and India for 23 years with The Burmah Oil Company, Ltd., as field superintendent and manager of prospecting operations.

At the same time, the following new appointments were announced by International Cementers:

Frank D. Smith, assistant general manager, formerly California division manager.

Robert D. Fagan, California division sales manager.

Jack Smith, as manager of foreign sales.

▸ **T. W. (Bud) Wheeler** will assume responsibilities in connection with the management of Loffland Brothers Company of Tulsa, Oklahoma, and will make his headquarters at Tulsa. He was first employed by Phillips Petroleum Company and was assigned to general field work in the Mid-Continent area. Until 1939 he held various positions with Phillips, becoming prior to his resignation general superintendent of the core drill division of the geological department. From 1939 until 1943 Wheeler was a partner and later sole owner of a drilling company operating in South Dakota, Texas, Louisiana, Illinois and Indiana. In 1943 he became associated with Kerr-McGee Oil Industries of Oklahoma City and for some time prior to his association with Loffland Brothers Company has been assistant to the vice president in charge of drilling.

▸ **Fred C. Schulze** has been appointed sales manager of the Waukesha Motor Company, Waukesha, Wisconsin. Schulze, who formerly was assistant sales manager, joined Waukesha Motor Company in 1928. He was active in various departments, including purchasing and plant engineering, before joining the sales department.

▸ **W. F. (Frank) Taylor** has been appointed manager of refinery sales, Bethlehem Supply Company. He succeeds T. B. Leech, who is resigning to join the Petro-Chem Development Company. Taylor is a native Oklahoman and has had over 22 years in the oil and supply industries. He spent 10 years with the Indian Territory Illuminating Oil Company, joining the Bethlehem organization in 1936, and has served in various departments since that time.

Concurrent with this change, **R. M. Berman** has been transferred from Corpus Christi, Texas, to Tulsa, Oklahoma, to handle the sale of Petro-Chem Iso-Flow Heaters, Super Heaters, and boilers.

Luther A. Myers is taking over the duties of Taylor. He served several years with Murray Brooks, Inc., and was sales manager for them prior to entering military service in 1942. His headquarters will be in Tulsa.

▸ **William B. Bell,** president of the American Cyanamid Company, has received the honorary degree of doctor of science from the Philadelphia College of Pharmacy and Science in Philadelphia, Pennsylvania. The degree was presented by Dr. Ivor Griffith, president of this Philadelphia college.

In making the award, emphasis was put on Bell's services in the field of public health and in the stimulation of pharmaceutical research. Bell has been president of American Cyanamid Company since 1922.

Guy A. Thompson A. W. McKinney Ted Sutter

Equipment Suppliers Gather for Annual Meeting

Members of the Petroleum Equipment Suppliers Association have concluded the 14th annual meeting of the Association at Colorado Springs, Colorado.

Guy A. Tompson, president of the Bethlehem Supply Company, Tulsa, Oklahoma, was elected president of the Association for the ensuing year to succeed A. W. McKinney, executive vice president of National Supply Company, Toledo, Ohio. Ted Sutter, vice president and general manager of Baker Oil Tools, Inc., Los Angeles, California, was elected vice president of the Association. Wharton Weems and H. R. Safford, Jr., were re-elected treasurer and general counsel, and executive secretary, respectively.

During the meeting the members heard a report from the general counsel covering legislative and legal developments on such matters as Basing Point Pricing, the Wage-Hour Law, Labor Relations Law, and other questions. Also, reports were given from the Statistical Research and the Sales Accounting Committees.

New directors were elected for the four districts.

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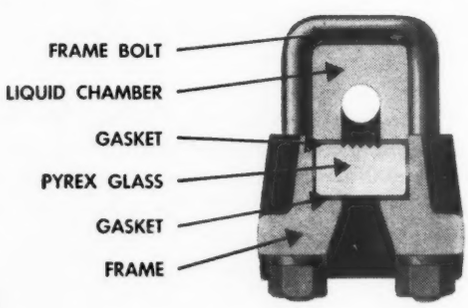
when you use

PENBERTHY Reflex GAGES

The refraction of light (an unvarying law of nature) makes the reading of Penberthy Reflex Gages unmistakable. Due to this refraction principle, the empty space always shows white—the space occupied by liquid always shows black. The dividing line between liquid and empty space is sharp and unmistakable, there can be no error in reading. It is easily read as far as you can distinguish between black and white.

Penberthy Drop Forged Steel Reflex Gages are available in whatever lengths required and for various liquids. They are also fabricated to customer's specifications from special alloys to meet unusual corrosive and temperature conditions. There is a Penberthy Gage of superior quality for every liquid level gage requirement.



PENBERTHY PRODUCTS

PENBERTHY INJECTOR COMPANY

DETROIT 2, MICHIGAN

Established 1886 • Canadian Plant, Windsor, Ontario

METHODS USED IN ESTIMATING NATURAL GAS RESERVES

Continuation of the discussion of factors in the volumetric formula.

The connate water factor is one that must often be estimated, for laboratory determinations are not always available.

Pressure and temperatures are usually obtained by measurement. In the event measurements are not available fairly accurate estimates can be made from the known rate of pressure and temperature increase with depth in the area.

The compressibility factor can be accurately determined by laboratory measurement. If laboratory measurements are not available reasonable estimates can be made by the use of published data. This factor is sometimes ignored by estimators; however, an error of as much as 30 per cent may result from its omission. This factor is especially large for gases rich in condensate and occurring at depths of 3500 to 4500 ft, in which case its omission results in underestimation of the reserve. (See Curve 1). Omission of this factor results in overestimation of the reserve in abnormally high pressure reservoirs frequently encountered below 10,000 ft in some areas of the Gulf Coast.

In calculating the compressibility factor at abandonment pressure, the estimator should consider changes in the composition of the gas that will occur as a result of cycling or retrograde condensation.

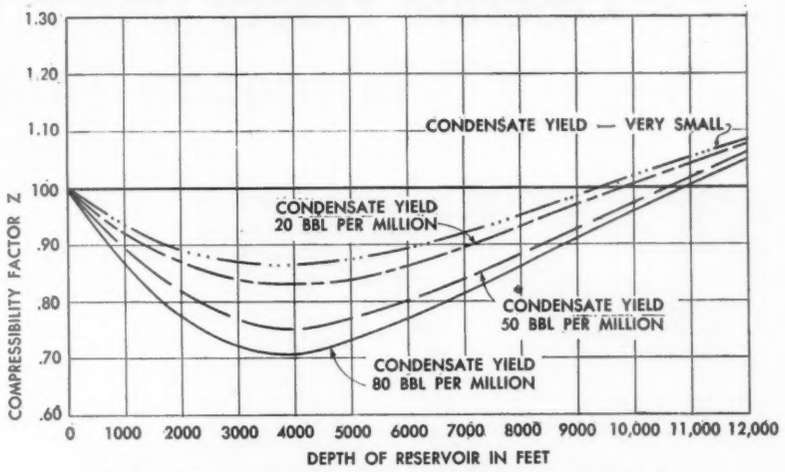
The authors' experience in checking estimates made by themselves and others indicates that the greatest errors in volumetric calculations are usually the result of incorrect determinations of net productive thickness.

Estimates of reserves in new or incompletely developed fields may vary widely because of errors in estimating the areal extent of production. To minimize these errors, subsurface data should be supplemented with geophysical data whenever possible.

The pressure bases ordinarily used vary from 14.4 to 16.7 psi. The estimator should be careful to indicate clearly the pressure base at which the reserves are stated. Reserves stated at a base of 14.4 psi will be approximately 16 per cent greater than the same reserves stated at a base of 16.7 psi. The base temperature is ordinarily 60 F.

The decline curve method. The pressure decline curve is one of the most widely used, and one of the most reliable of the several means of estimating gas reserves in those reservoirs that do not have a water drive. Several types of pressure decline curves are used. One or more of these curves should be constructed for each reservoir studied to determine whether a water drive is present and its relative importance.

Early pressure decline curves were constructed from closed-in wellhead pressures, sometimes referred to as "rock pressures." Since the development of methods of measuring and calculating reservoir pressures, most engineers and geologists use reservoir pressures in plotting decline curves.

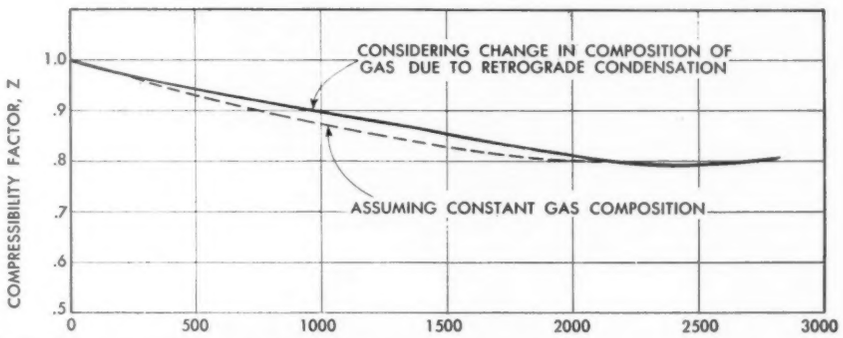


CURVE 1. Curves showing change in the compressibility factor with depth and composition of the wet gas.

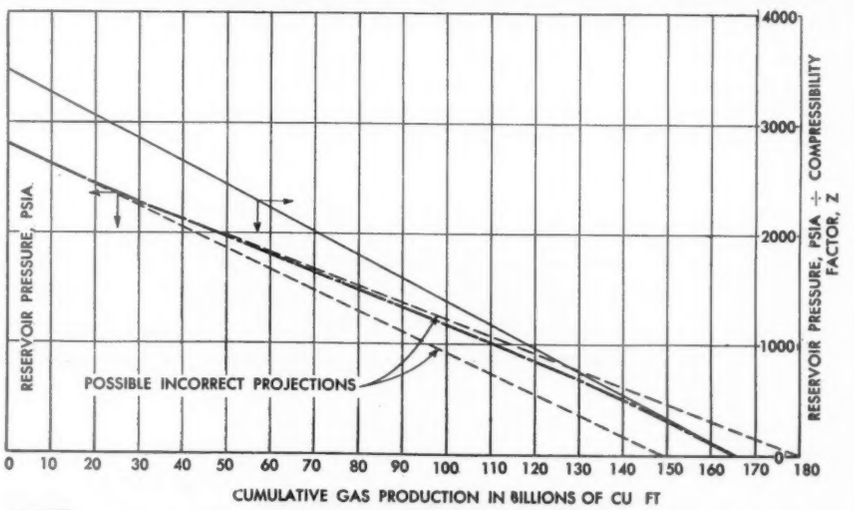
In the event a water drive is not present wellhead or reservoir pressure plotted against cumulative production may be extrapolated in a straight line to the expected abandonment pressure, and the ultimate recovery read direct. Estimates made in this manner ignore the effect of deviation from Boyle's law.

When the accuracy of other data justify refinements, reservoir pressure divided by the compressibility factor (Z) may be plotted against cumulative production to correct for the effect of deviation from Boyle's law. (See Curves 3 and 4).

CURVE 3. Variation of compressibility factor "Z" with production at reservoir temperature of 188 F for a wet gas having an initial gravity of .812.



CURVE 4. Comparison of theoretical reservoir pressure—cumulative production curve with theoretical reservoir pressure divided by Z—cumulative production curve.


4000
3000
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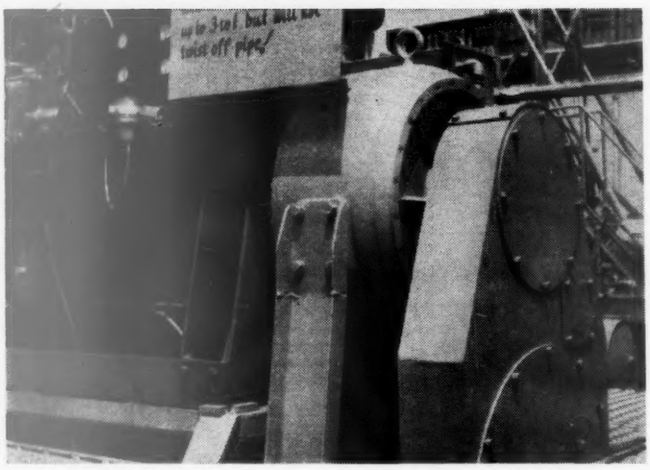
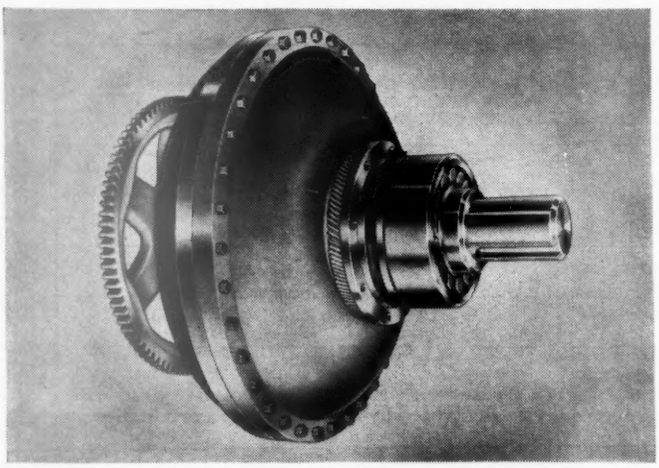
RESERVOIR PRESSURE, PSIA
RESERVOIR PRESSURE, PSIA ÷ COMPRESSIBILITY FACTOR, Z
POSSIBLE INCORRECT PROJECTIONS
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180
CUMULATIVE GAS PRODUCTION IN BILLIONS OF CU FT

Taken from the article, "A Critical Review of Methods Used in the Estimation of Natural Gas Reserves," by Henry J. Gruy and Jack A. Crichton, published in *The Petroleum Engineer*, October, 1948, pages 208 to 220 inclusive.

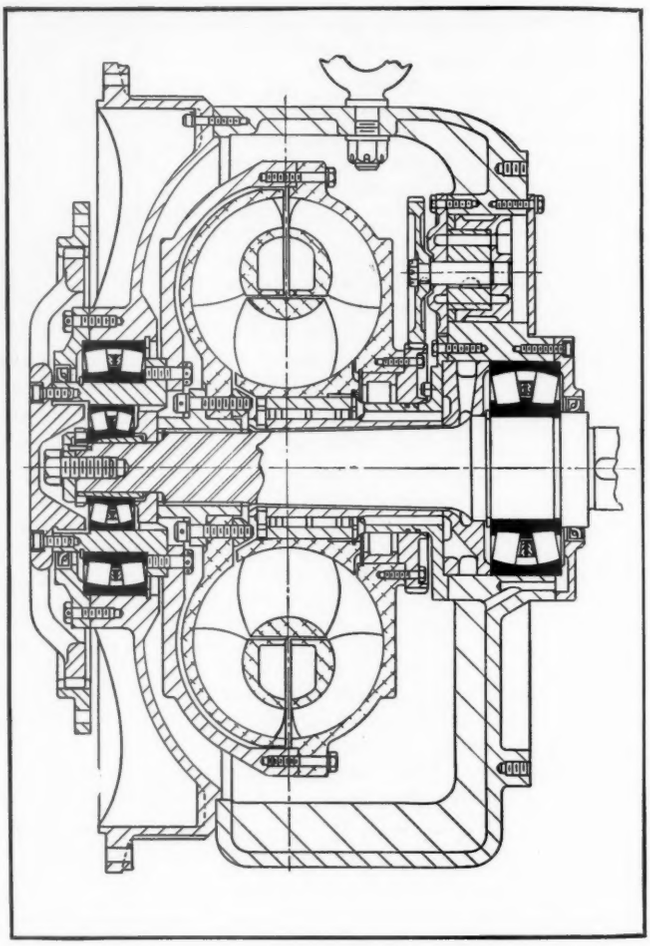
Torrington Spherical Roller Bearings Operate Freely Under Deflection in TORCON Torque Converters



An efficient transmission for a rotary table drive, above, or for other oil field and industrial machinery, the Torcon is a hydraulic torque converter and coupling in one. For smooth, trouble-free operation, it is equipped with Torrington Spherical Roller Bearings.

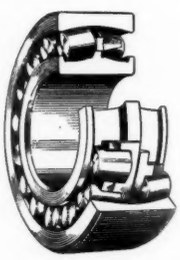


No detail that might increase the efficiency and reliability of the Torcon (Schneider System) has been omitted by Torcon Corporation, Chagrin Falls, Ohio. That's why high-capacity Spherical Roller Bearings are used on the input and output shafts.



One problem solved by the use of Spherical Roller Bearings is deflection of the output shaft, caused by overhung sprocket loads. The application of self-aligning bearings, shown in cross-section, permits the use of a right angle chain drive, without an outboard bearing. Long service life is assured by the high capacity and smooth operation of Torrington Spherical Roller Bearings.

Design for greater efficiency, longer service life and lower maintenance costs with Torrington Spherical Roller Bearings. Our engineers will be glad to help you. Write us today. THE TORRINGTON COMPANY, South Bend 21, Ind., or Torrington, Conn. District offices and distributors in principal cities of United States and Canada.



TORRINGTON SPHERICAL ROLLER **BEARINGS**

Spherical Roller • Tapered Roller • Straight Roller

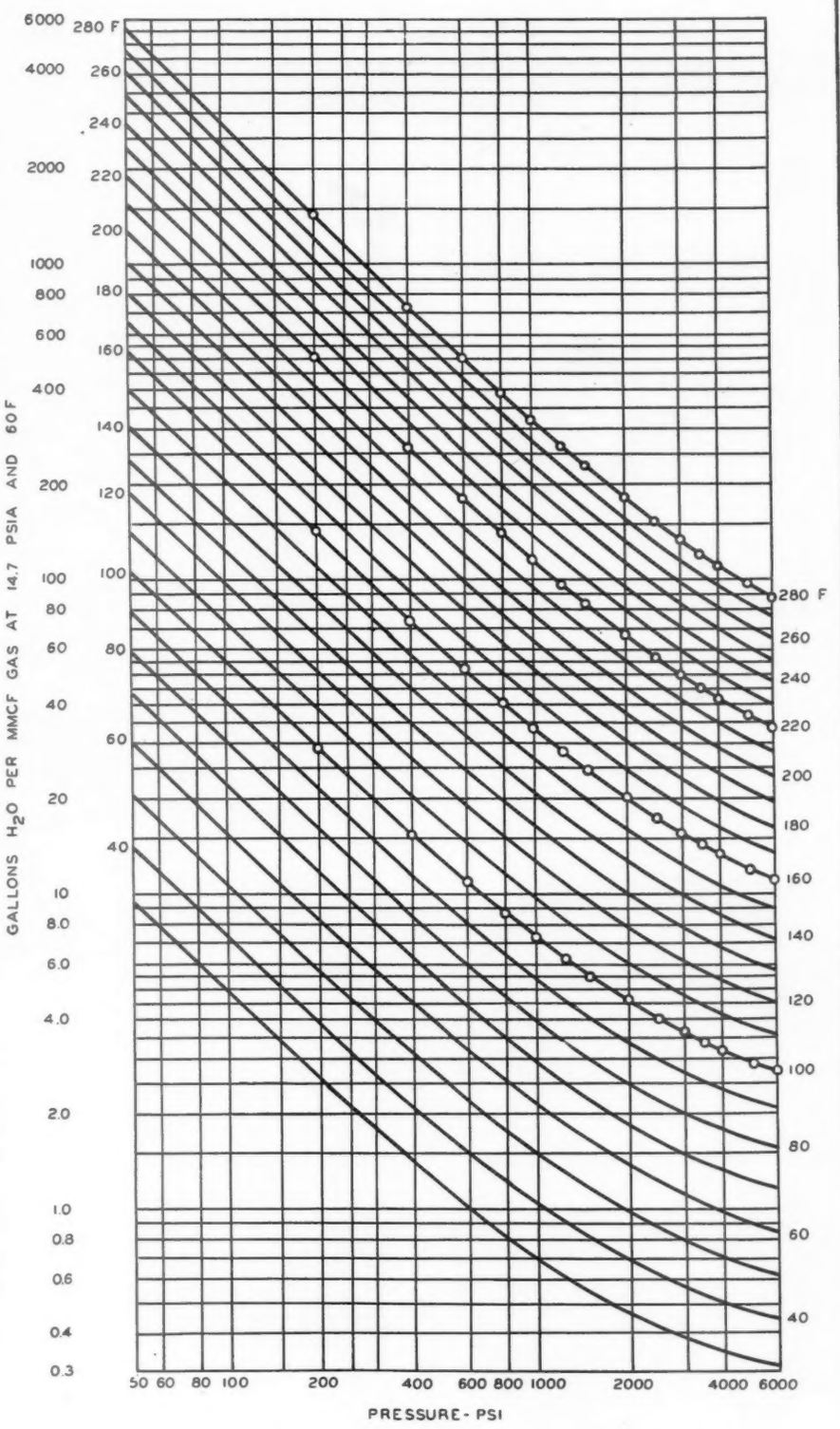
Needle • Ball • Needle Rollers

MOISTURE CONTENT OF SATURATED NATURAL GAS, AT VARIOUS TEMPERATURE PRESSURES

The accompanying chart shows the water content of saturated natural gas at extended ranges of temperatures and pressures. This chart should be substituted for Fig. 1, page C-32, May, 1949 issue of the Refining and Gas Processing Edition of The Petroleum Engineer.

In discussing the removal of liquid water mechanically from gas, Parks (Prevention of Freezing of Gas Lines), says that in a well with 3000-lb surface pressure will have reservoir pressure and temperature conditions that will maintain in the gas water vapor to the extent of about 25 gal per million cubic feet. Under conditions of operation this water content is reduced to about 3.6 gal per million cubic feet. Or, 21.4 gal of water per cubic foot will be condensed to liquid by the process of operating the well to produce gas. Hydrate troubles will be eliminated when and if the gas is reduced to 600 psig line pressure, at either 100 or at 70 F, provided the water has been removed effectively. The effect of water removal at the highest pressure point in the system also will result in lowered corrosion rates and in operating low pressure separators at lower temperatures with increased yields of liquid.

Determination of these principles has resulted in the development of several equipment units for the removal of water from gas streams. These include the Parks Liquid Knockout, the Aerotec Tube, the latter having been developed originally during the war to remove dust from air streams to internal combustion engines. It was found in the Aerotec unit that water injected to aid in dust removal was itself removed completely.



NOTE: *Circles represent dewpoint gas in methane-water system.*

WHERE *Visco* TREATMENT PAYS OFF

PAYOFF on any lease is treated oil acceptability . . . and that is where Visco Emulsion-Breaker speed and efficiency give you assurance that every tank is sold, every time.

Get Visco treating advantages on your lease now — to assure consistent payoffs at the pipelines . . . And to prove, on *your oil*, that real emulsion-breaker economy shows up in the cost per barrel of dry oil *sold*.

VISCO PRODUCTS COMPANY
INCORPORATED
City National Bank Building
Houston 2, Texas

Phone Houston, CAPITOL 7300, collect, for Visco Service that matches Visco Chemicals — fast, efficient, economical!

Visco CONSISTENTLY EFFICIENT
DEHYDRATING AND DESALTING CHEMICALS

NOTICE: Visco Products Company is authorized to manufacture and sell Visco Oil Treating compounds for use in the breaking and resolving of oil emulsions, and to grant licenses for such use, under the following United States patents: 1,850,562; 1,860,663; 1,913,330; 1,937,259; 2,050,639; 2,050,640; 2,206,589; 2,214,733; 2,214,734; 2,225,189; 2,303,414; 2,307,513; 2,318,034; 2,318,035; 2,321,056; 2,325,554. Re 20,717 and patents pending. Any purchaser of Visco Oil Treating compounds is authorized to use the same in the treating, breaking and resolving of oil emulsions in accordance with the above patents. The royalty for such use is included in the purchase price. Visco Products Company is authorized to and is willing to grant licenses on a royalty basis, to all companies, and to others desiring to practice the patented subject matter, under any and all of the above patents, permitting the user to purchase the oil treating compounds at will from any vendor, and to prepare the compounds for use under the above patent or patents, at a royalty charge of 20 cents per gallon. Application for license should be made to Visco Products Company, Houston, Texas

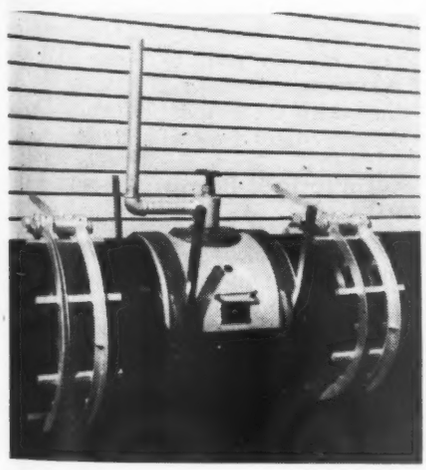
new and improved machinery and equipment

A REGULAR FEATURE
appearing in
THE Petroleum Engineer
Irwin-Keasler Building
Dallas 1, Texas

(1) Pipe Line Patch

The Tipton electric weld high pressure pipe line patch has been perfected through many years of field testing and engineering. Electric welders have found this patch to be completely safe for use in repairing leaks on modern high pressure pipe lines.

The main safety features of the pipe line patch are the specially designed gasket to seal off the pressure and the specially designed vent plug that allows the gas, oil, or other fluids to be vented away while the patch is being installed.



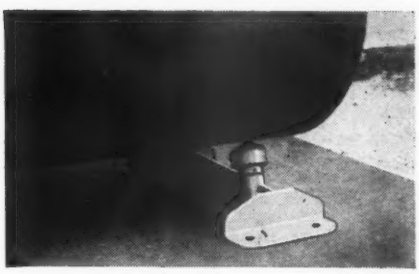
The patch can be installed while a line is in operation, thus avoiding shutting out and draining line. On large diameter high pressure gas pipe lines this would save approximately five or six hundred thousand cubic feet of gas per mile, depending on operating pressures. Also, it would save the labor necessary to shut-out, drain, pack, and return a line to service.

The patch is manufactured by General Manufacturing Company, Okmulgee, Oklahoma.

(2) New Pipe Line Dolly

A new pipe line dolly has recently been developed by the Reed Engineering Company, Carthage, Missouri, for movement of pipe in both yard installations and field operations. It consists primarily of two large, heavy-duty steel balls, supported by ball bearings, mounted in a welded, lightweight steel framework of rugged construction.

The ball type supports and casters permit rotation or endwise movement of pipe on the Reed dolly, presenting a distinct advantage over the old type which permits movement in only one direction, states the manufacturer.



The ball mechanism is shielded from foreign matter, permitting use of the Reed dolly under the most adverse field conditions.

Reed dollies are available in several standard sizes to accommodate any diameter or weight of pipe.

Get Full Details of July, 1949, Listing—Check and Mail Coupon to

THE PETROLEUM ENGINEER

P. O. Box 1589, Dallas, Texas

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COMPANY NAME .....

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HELICOID GAGE BOURDON TUBES:

- ✓ K-MONEL
- ✓ ALLOY STEEL
- ✓ STAINLESS STEEL
- ✓ PHOSPHOR BRONZE

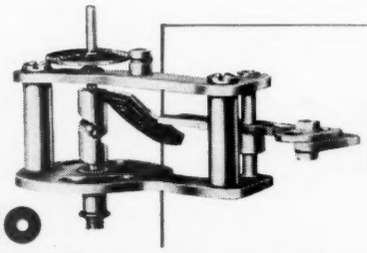
Make Sure You Select The Right One

• It pays to use the right kind of gage for the job. For example, a gage made with a K-Monel Bourdon tube won't corrode on certain services which ruin bronze or steel or even stainless steel Bourdon tubes in a short time.

Some such services are Hydrogen Sulfide (sour oil or gas), Hydrofluoric acid, Aluminum Chloride, Aluminum Fluoride, Ammonium Sulfate, Black Liquor, Carbon Tetrachloride, Ethyl Chloride, Oxygen, Potassium Sulfate, Sodium Fluoride, Sodium Hydroxide, and many others.

HELICOID developed the K-Monel Bourdon tube to give better and longer gage service—to eliminate trouble—to reduce cost. Helicoid K-Monel gages are guaranteed accurate to ½ of 1%. They stay accurate longer.

Of course, bronze or alloy steel or stainless steel Bourdon tubes are each best under certain conditions. It depends on the service. Use the right gage for the job. Write us if there's any doubt.



Only Helicoid Pressure Gages have the Helicoid Movement

ACCO

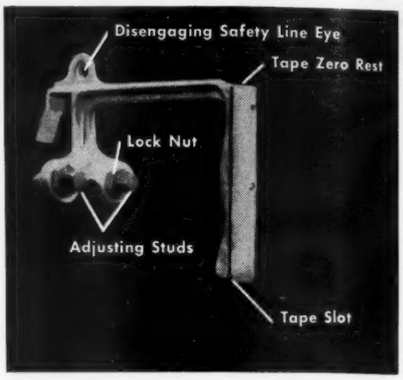
HELICOID GAGE DIVISION
AMERICAN CHAIN & CABLE
Bridgeport 2, Connecticut

TRADE MARK

(3) Tape Hanger

A new adjustable tape hanger, designed by a drilling engineer, to help measure drill pipe and tubing in strain accurately and quickly has been announced by Samar Tool Company, Houston, Texas.

The tool measures 10 in. overall, weighs 1¾ lb, is made of non-corrosive metals, and is adjustable so as



to fit 2 in. EUE tubing, 2½ in. EUE tubing, or larger, and any standard tool joint. This adjustable tape hanger has three points of rest. It can be leveled easily, and because it will fit drill pipe or tubing, strain measurements for both can now be made with just one tool.

It is placed on the pipe by the derrick man while the pipe is moving. The pipe is then pulled on up and measured in strain. This new tool places the zero point of the tape level with the top of the collar of tool joint but outside the elevator. The hanging tape is then pulled down and the measurement taken. You save rig time with the Samar adjustable tape hanger, states the manufacturer.

(4) Plunger Pump

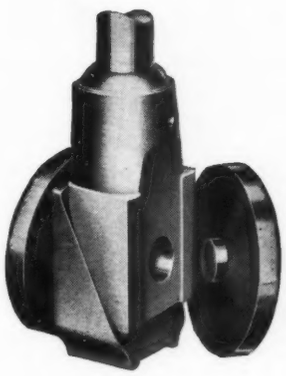
A new type of pump known as Fig. 3364—2¼ in. by 3 in. horizontal triplex plunger pump—has just been announced by Gaso Pump and Burner Manufacturing Company, Tulsa, Oklahoma.

The latest addition to the Gaso series has a capacity of up to 44 bbl per hour at 900 lb working pressure. Primarily designed for small oil leases, with special application to crude oil gathering systems, salt water disposal and fresh water supply, Fig. 3364 is adaptable to any service calling for a rugged, high pressure unit having a capacity of from 22 to 44 bbl per hour. The new Gaso model is available as a complete pumping unit, with any make of gas, gasoline, or diesel engine, or electric motor.

It is equipped with a molybdenum alloy cast iron fluid end for oil service or with an aluminum-bronze fluid end for corrosive fluids.

How Darling features prevent trouble and expense

UNIFORM WEAR DISTRIBUTION



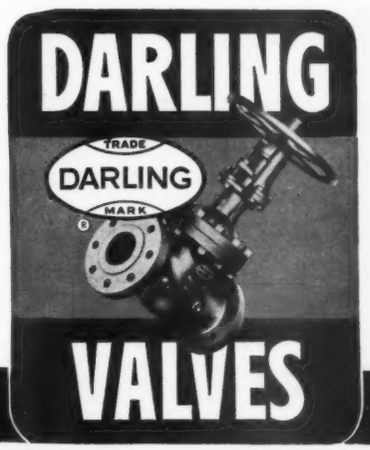
A LARGE percentage of valve leaks, lost time, expense, can be blamed on uneven wear—the uneven wear caused by repeatedly exposing the same disc and seat areas to concentrated pressure, fluid flow, and resultant galling from operation.

For years such leaks were considered the result of normal, expected wear. But the unique design of Darling Double Disc Parallel Seat Gate Valves has proved that uneven wear can be prevented. The two valve discs shown in the cutaway view, and again in the removed inside assembly, are separately and independently hung and free to revolve through their 360°. Valve operation aids the action during the lowering and raising of the disc assembly. The discs never seat twice in the same position and obviously wear is bound to be uniform. This results in tight closure even when the disc faces are worn.

Hundreds of Darling gate valve users have learned by experience that uniform wear distribution results in longer service life and correspondingly lower maintenance cost.

DARLING VALVE & MANUFACTURING CO.
Williamsport 2, Pa.

Outline your service requirements and get complete *information on Darling Valves of the proper type. Or, send for the complete 300-page Darling Catalog No. 17M. It describes Darling Valves of* all *types for* every *normal or unusual service, and for pressures up to 1500 pounds. It's full of helpful information... Yours for the asking.*



*This advertisement is one of a series showing how the unique Darling Fully Revolving Double Disc Parallel Seat Gate Valves answer the following critical operating problems:

- Positive, easy closing—regardless.
- Automatic adjustment for valve body distortion.
- Elimination of disc-to-seat friction and galling.
- Uniform wear distribution.
- Extreme simplicity.
- Greater service life.
- Simplified maintenance.

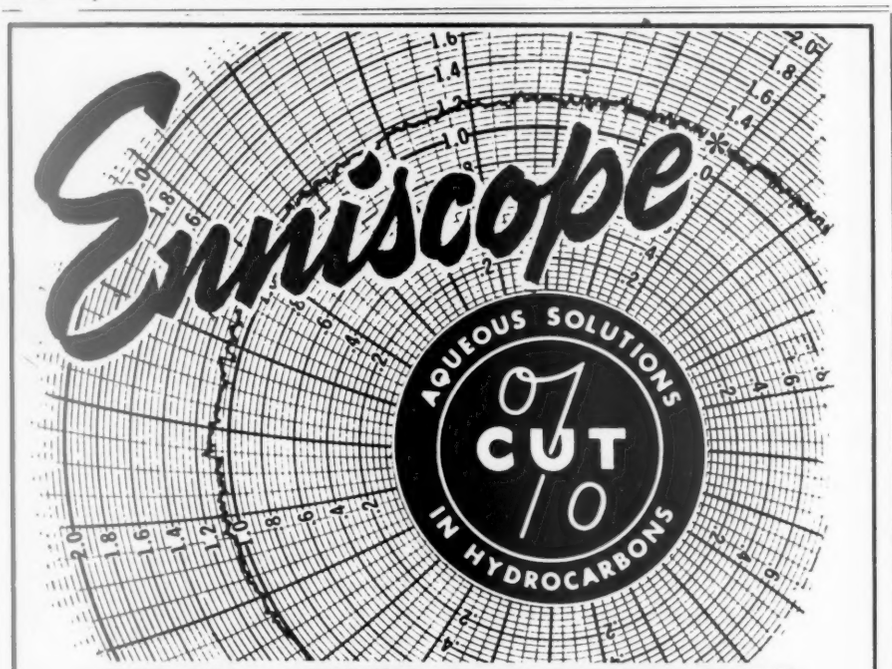
CORROSION RESISTANT VALVES

In addition to conventional iron, bronze and steel constructions, Darling specializes in valves for any corrosive fluid: iron body valves with special alloy trim; iron body, rubber lined, with special alloy trim; all bronze; and all special alloy. Darling's 50 years of experience in meeting unusual requirements is always at your service.

THE VALVE MARK OF QUALITY . . . WATCH FOR IT

(5) Rediation Detector

The Nuclear Development Laboratory is presenting for the first time a low cost midget portable radioactivity detector, which has an unusual accuracy and sensitivity. The development of this new radiation detector (Model PRD1) has been made possible by the invention of a remarkably compact electronic scaling circuit which, is used to automatically add up pulses from a large Bets and Gamma Ray sensitive Geiger Mueller Counter tube. The random nature and rapidity of the pulses from a large Geiger Counter tube makes it necessary to use some form of integrating circuit to average out the corresponding fluctuations in determining the average counting rate. For reading high radiation intensities a counting rate meter may be advantageously employed, but for low intensities it becomes necessary to utilize an automatic adding circuit (commonly termed a scaler) to totalize the pulses in a given time interval in order to establish an accurate value of radiation intensity. Thus, for the first time, the Model PRD1 Radioactivity Detector makes it possible to do accurate radioactivity survey work and Uranium prospecting with a small, light-weight instrument.



CUT-RECORDER

The Enniscope Cut-Recorder is the product of years of trial and research and will do the heretofore impossible feat of giving a written record of the cut at all times, and within practical limits.

Office Memo:

Brice
Write this one up
for the dope.
Just what we have
been needing
R.L.F.

*Trade name of Cut-Recorder and Tank Bleeder.

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West Texas:
LEE FLOOD, P. O. Box 1801, Midland, Texas

California:
Technical Service Co., 2425 Gundry Ave., Long Beach 6, Calif.

Export:
H. H. HARMAN, 122 East 42nd St., New York 17, N. Y.

Developed by:

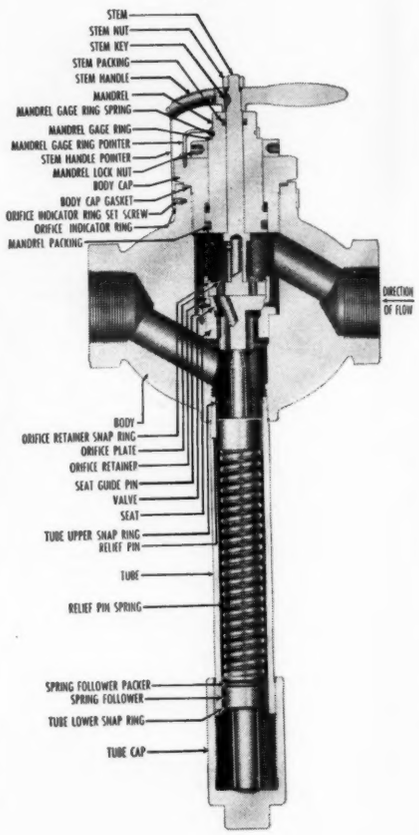
Oil Well Water Locating Co.

2230 LEMON AVE. LONG BEACH 6. CALIFORNIA

(6) Automatic Flow Control

The Bowen automatic flow control manufactured by S. R. Bowen Company, P.O. Box 427, Santa Fe Springs, California, is a completley new and revolutionary device for producing wells. It is installed on the flow line at the well head and brings to operators many desirable features that were previously unobtainable. Extensive field tests have shown that the Bowen automatic flow control: automatically controls production; prevents excessive loading; permits positive regulation at the lowest possible gas-oil ratio; reduces paraffin problems to a minimum; and, controls gas surges.

Bowen automatic flow controls consist essentially of a body, a spring-loaded valve, and an adjustable orifice plate. The body provides the connections to the flow lines; the spring loading on the valve is controlled by adjusting the tube cap; the amount that the valve can open is controlled by adjusting the mandrel; the desired orifice in the orifice plate is selected by adjusting the stem handle.

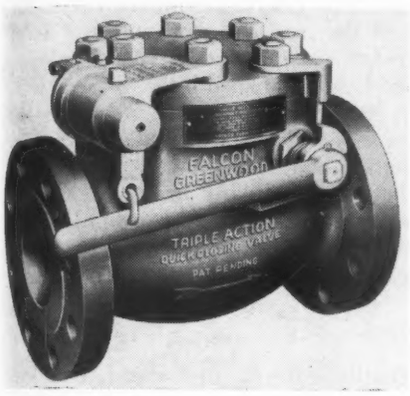


Pressure recorders are recommended accessory equipment for Bowen automatic flow controls. They assist the operator in the proper setting of the unit and the charts will indicate when adjustments are necessary. An outlet is provided in the body for installation of a pressure recorder.

(7) Quick Closing Valve

Built on Greenwood patents the Falcon-Greenwood quick closing valve designed by Falcon Products, Inc., Pomona, California, is primarily for refinery and gasoline plant use. The valve operates either automatically or manually to instantly shut off the flow of gasoline or natural gas within the refinery, butane plant, or other fire hazardous units.

Built for high pressure work the valve fits into the line much like a check valve. The action or movement of the shutoff gate is termed "triple action" in that it may be operated by one of three different methods; either



(8) Dual Truck Pumps

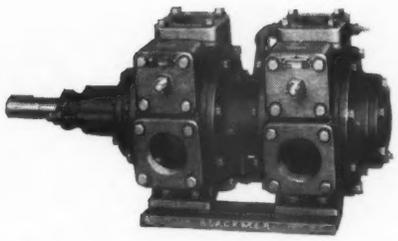
automatically through a fusible link or through a hydraulic or pressure system or it may be operated manually from some remote point by means of a pull system. The valve is easily reset to its open position within a few seconds.

Blackmer Pump Company, Grand Rapids, Michigan, has announced dual truck pump units in three sizes, 40, 60, and 100-gpm capacities, designed to provide carriers with load-handling equipment to meet legal and insurance requirement for split-load gasoline and fuel oil carriers.

According to B. L. Gordon, president, the new dual unit permits separate or simultaneous unloading of one or two truck tank compartments.

Known as the Models DTR-40, DTR-60 and DTR-100, the pumps are reported to be unusually quiet due to the use of nonmetallic sliding vanes. Model DTR-40 consists of two 40 gpm units mounted on a common base, in line, with a single stainless steel shaft. It was considered advantageous to use in-line mounting to permit space saving as compared to mounting two pumps singly.

The largest size, Model DTR-100, may be manifolded to serve as a single



suction and discharge pump of 200 gpm capacity. Gpm capacities are rated at 500 to 575 rpm and 40 psi, based on tests using No. 2 fuel oil. Gasoline ratings are computed at 5 per cent under the gpm rating for oil.

The basic problem of preventing leakage of gasoline to the fuel oil half or vice versa was accomplished by an inserted dual sealing element in a self-contained cartridge. The seal is spring-loaded and includes both chevron packing and mechanical rotary seal features.

Nonmetallic sliding vanes are actuated by push rods and are said to be self-adjusting for wear and operate with sustained quietness. Other features reported include ball-bearing design with grease retainers, and chatter-proof relief valves of new design, which it is said will maintain constant pressure even during bypass of total pump capacity.

DEAN BROTHERS PUMPS INC. INDEANAPOLIS, PUMPING MACHINERY INDEANA.

ESTABLISHED 1869

DEAN BROTHERS PUMPS INC.

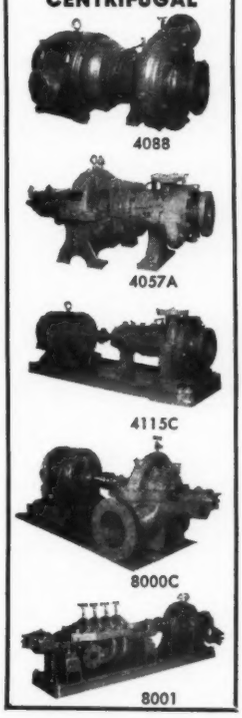
INDIANAPOLIS IND.

323 W. TENTH ST.

PUMPS

BUILDERS OF OUTSTANDING PUMPS SINCE 1869

CENTRIFUGAL



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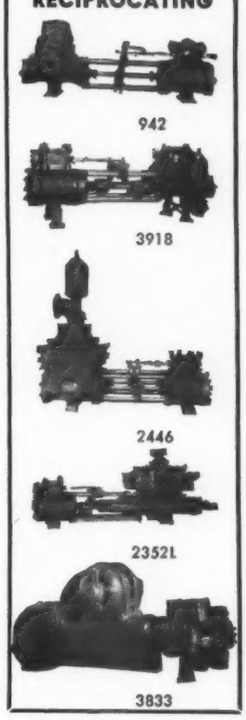


BRANCH OFFICES: NEW YORK HOUSTON

trade literature

PUBLICATIONS LISTED ARE SENT FREE UPON REQUEST

(9) Chromium-Iron

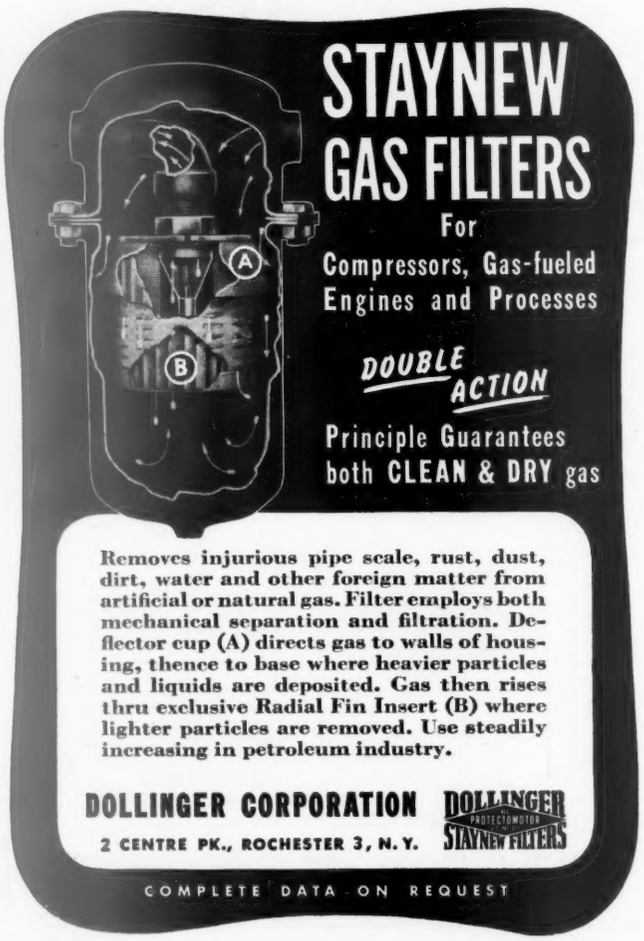
The properties and characteristics of 27 per cent chromium-iron are comprehensively presented in a 30-page bulletin reprinted from an article by H. D. Newell, chief metallurgist of The Babcock and Wilcox Tube Company. It is illustrated with numerous photographs, tables, and graphs prepared by the company's research department. Among the subjects covered are properties at elevated tempratures, impact properties and notch sensitivity, structural characteristics, embrittlement phenomena, working and fabricating, and heat treating.

The bulletin, TR-506, will be sent free on request to The Babcock and Wilcox Tube Company, Beaver Falls, Pennsylvania.

(10) Jet Process

A new bulletin describing the Welex Jet Services' new torpedo jet process has just been released by that company. This is a new process that brings to open hole blasting the scientific precision that is used in perforating, well logging, and other similar oil well services.

For further information write Welex Jet Services, Inc., Fort Worth, Texas, for Bulletin No. JP-149.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GAS FILTERS
For
Compressors, Gas-fueled
Engines and Processes
DOUBLE ACTION
Principle Guarantees
both CLEAN & DRY gas
A
B
Removes injurious pipe scale, rust, dust, dirt, water and other foreign matter from artificial or natural gas. Filter employs both mechanical separation and filtration. Deflector cup (A) directs gas to walls of housing, thence to base where heavier particles and liquids are deposited. Gas then rises thru exclusive Radial Fin Insert (B) where lighter particles are removed. Use steadily increasing in petroleum industry.
DOLLINGER CORPORATION
2 CENTRE PK., ROCHESTER 3, N. Y.
DOLLINGER
PROTECTOMOTOR
STAYNEW FILTERS
COMPLETE DATA ON REQUEST

(11) High Vacuum Equipment

A new bulletin, a revision of Cenco's 48-page bulletin containing technical information and descriptive data on high vacuum pumps and accessory apparatus, systems, connections, pumping speeds, etc., has been released by the Central Scientific Company, 1700 Irving Park Road, Chicago 13, Illinois.

The revised bulletin contains information on the new pressovac pump for pumping to 25 microns and the Cenco-Hypervac 23 Pump, a fast pumping unit for pressures to 5 microns or mercury. Its free air displacement is 240 liters per minute. The hypervac 23 is sold complete with ½ hp motor. Persons interested in high vacuum should send for a copy of Cenco's free engineering Bulletin 10A, "High Vacuum Equipment."

(12) "Steel Making in America"

"Steel Making in America" describes, in simple terms, the manufacture of steel in the United States from raw materials through finished steel products ready for shipment from the mills. A brief history of the iron and steel industry from earliest times to the present is also included.

The book was prepared and published by U. S. Steel Corporation, 71 Broadway, New York, New York, primarily for school students in response to thousands of requests received from pupils for information about steel making.

U. S. Steel hopes that "Steel Making in America" may prove helpful, not only to students, but also to adult laymen, who desire to further their knowledge of the manufacture of the basic metal, steel, which serves them so extensively in their daily lives.

(13) Generators

Allis-Chalmers alternating-current, high-speed, coupled-type generators are described in a new 8-page bulletin released by the company.

Construction features of both the bracket and pedestal type bearing synchronous generators are given in this bulletin along with a table of ratings of standard bracket bearing generators. Bracket bearing contruction is generally used for the smaller sizes for ratings up to 1 kva per rpm, while pedestal bearing construction is generally used for ratings above 1 kva per rpm and for all generators above 1000 kva. according to the bulletin.

Copies of "Allis-Chalmers Alternating-Current, High-Speed, Coupled-Type Generators," Bulletin 05B6031B, are available upon request from Allis-Chalmers Manufacturing Company, 1060 S. 70th Street, Milwaukee, Wisconsin.

(14) Tower Operation

In question and answer form The Marley Company, Inc., describes cooling tower operations giving such things as a table on operating costs of a pump for a cooling tower, etc. For a copy of this form just write to the company in Kansas City 15, Kansas.

(15) Plug Valve

A two-color brochure was recently made available by Johnson Foundry and Machine Company, 1119 North Main Street, Los Angeles, California, to those who may be interested in its plug valve design. This valve, which requires no lubrication and from which all wearable parts may be removed without freeing the valve body from the line, is a quickly operating, easily controlled unit for high pressure installations.

In addition to a comprehensive treatment of the above mentioned product, the brochure contains factual information about the LJS line of flow beans. These beans incorporate many of the design features of the new plug valve and combine them with the fundamental operating characteristics demanded of high fluid pressure controls.

(16) "Western Canadian Oils"

A new booklet, "Western Canadian Oils," has been published by James Richardson & Sons, a brokerage concern with headquarters at Winnipeg, Canada. This booklet contains information on the drilling, exploration, and production in Canadian fields. It explains how to read the Canadian maps, includes maps of the larger fields, and production graphs. The latter half is devoted to descriptions of the oil companies operating in Canada.

(17) Relief Valve

Bulletin 711, containing the latest information on forged steel relief valves, has been issued by Edward Valves, Inc., East Chicago, Indiana. Included in this bulletin is complete information on dimensions and weights, design detail, and correct installation.

Edward all-steel relief valves are designed for a basic steam, oil, or vapor working pressure of 600 psi at 850 F, but can be equipped with special carbon springs for more severe service conditions.

(18) Pipe Tools

A new 52-page catalog covering the complete line of Toledo pipe tools, power pipe machines, power drives, and accessory equipment, is announced by the Toledo Pipe Threading Machine Company, Toledo, Ohio.

A suggestion of the wide range of use of these tools is presented pictorially in a dramatic photograph of the city of Toledo's skyline, which serves as a continuous front and back cover for the catalog.

The catalog describes and illustrates hand-operated pipe tools of all types in capacities up to 12-in. pipe; power pipe machines in three models for ½-in. to 4-in. pipe; power drives in three models for operating geared pipe threaders, and also for other jobs where power is needed such as opening sluice gate valves, turning a boring bar, operating winches, turning sheet metal rolls, etc.; and supplies and accessory equipment.

(19) Walkways and Loading Racks

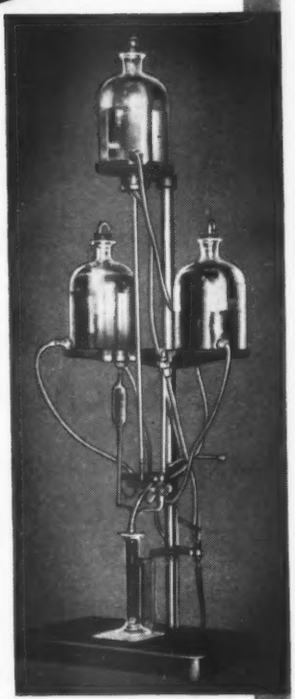
Safwalk walkways and loading racks of Black, Sivalls & Bryson, Inc., are shown in a recent catalog (No. 54, section 6, part 1) of the company. Safwalk material is vari-sized, all steel, pre-punched and pre-cut units used for the construction of gauging walkways and stairways on oil field storage tanks, as well as for tank car loading rack, pumping unit platforms and manifold walks.

HECO Offices and Plant at Houston

The Houston Equipment Company, Inc., has moved into larger and better equipped quarters. Both shops and offices are now located at the new address at 5513 Clinton Drive, Houston 10, Texas.

Newly designed and patented features have increased the sale of HECO pipe cleaning and priming machines and machine parts. This fact, together with the fact that other pipe line products are being added to the HECO line, caused the management to seek better manufacturing facilities.

SULFUR and CARBON *Analyses* in PETROLEUM PRODUCTS

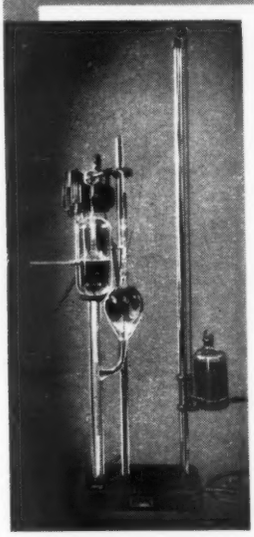


The sulfur content of oils, waxes and greases is often an important measure of the value and quality of the product.

Whether the desired sulfur content be high, low or medium, it is necessary to know exactly what amount is present.

The combustion method offers a rapid and sure means of determining sulfur in the wide range of percentages and materials encountered in the oil and grease field.

The Dietert-Detroit Sulfur Determinator embodies the correct principles of the combustion method in a simple, rugged and convenient form. It is supplied complete to operate as a self-contained unit, independent of other analytical equipment. Complete analysis can be made in less than five minutes.



Carbon determinations on organic compounds are being made in as little as two minutes with the Dietert-Detroit No. 3003 Carbon Determinator.

This method can be applied to any petroleum product that can be weighed into an open combustion boat. One example of the usefulness of this method is the analysis of cracking catalyst for carbon content.

Leading oil companies* are taking advantage of these versatile, time-saving determinators. Write for detailed information on how you can apply rapid carbon and sulfur analysis to your problems.

*Two typical users— THE SHELL OIL COMPANY / THE PURE OIL COMPANY

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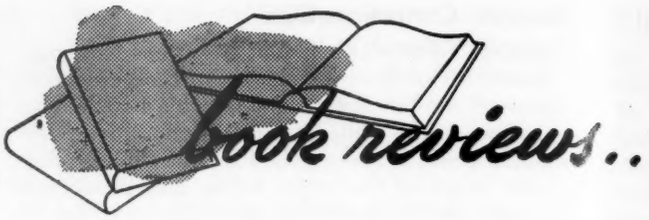

▸ **Celeste,** *by Rosamond Marshall, Prentice-Hall, Inc., New York, New York. Pages, 242. Price, $2.75.*

The early oil industry serves as a background for a frothy, romantic novel. Rich oil strikes and fights to obtain rights to the "black gold" serve as the stage setting for some rather torrid love scenes. No holds are barred in the struggle for oil leases in this story of early days of the California boom.

▸ **Principles of Petroleum Geology,** *by Cecil G. Lalicker, Appleton-Century-Crofts, Inc., 35 West 32nd Street, New York, New York. Pages, 365. Price, $5.00.*

In this book the author has given in detail the stratigraphic and geographic distribution of petroleum. Emphasis has been placed on principles of petroleum geology, the mode of origin of oil and gas structures, and petroleum discovery methods. Oil and gas fields described in this book have been selected from various petroliferous provinces in the world, and are grouped according to their origin.

▸ **Fuels and Lubricating Oils,** *by B. Pugh and J. M. A. Court. Pitman Publishing Corporation, 2 West 45th Street, New York, New York. Pages, 166. Price, $3.50.*

The very wide subject of fuels and lubricating oils for internal combustion engines is dealt with in a comparatively elementary manner. The authors have compiled a text book limited to that necessary to the understanding of the elements of lubrication and engine lubricating oil specification tests for the engineering student. Many branches of the subject have been left untouched, and others are only briefly treated. The volume does not touch on the subject of gaseous fuels, since an adequate treatment would occupy a space in this volume altogether disproportionate to their use in practice.

▸ **Patent Law for the Executive and Engineer,** *by Harry Aubrey Toulmin, Jr. Research Press, Inc., Dayton, Ohio. Pages, 231. Price, $2.95.*

The contents of this book serve as an orientation course in patents. The author is a corporation lawyer, who has represented hundreds of corporations in patent work. Little has been written about patents and patent laws, one of the most complex and elusive phases of American business. Though governments have undertaken to provide an assurance of reward, subject to certain conditions failure to understand the nature of these conditions, and the everyday application of the patent law has led to disappointments, disagreements, and oftentimes complete loss. The author deals with such subjects as how to get a valid patent, what can and cannot be patented, and protecting research profits.

▸ **Standard Welding Terms and Their Definitions.** *American Welding Society, 33 West 39 Street, New York, 18 New York. Pages, 50. Price, $1.00.*

This booklet has just been published by the American Welding Society, after four years' effort to formulate a suitable, standard terminology for welding. Because the number of terms have increased so much, they have been grouped dictionary-wise in alphabetical order. There has also been included a listing of all the terms grouped according to processes, and the accompanying figures have been grouped together rather than dispersed throughout the text.